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PRELIMINARY REPORT ON LOCAL ANESTHESIA OF THE EYE

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On Sept. 15, 1884, this preliminary report on the "Introduction of Cocaine as an Anesthetic for the Eye," was read by Dr. Brettauer, for the author, Dr. Carl Koller, at the meeting of the German Ophthalmological Society, at Heidelberg. At the suggestion of Dr. J. W. Nordenson, of Stockholm, a translation of the original publication is herewith brought to the attention of the readers of the ARCHIVES OF OPHTHALMOLOGY, in commemoration of the fiftieth anniversary of this epoch-making discovery, and as a small tribute to Dr. Koller.

It is a well known fact that the alkaloid cocaine, which is obtained from cocoa leaves (Erythroxylon coca), makes the mucous membrane of the throat and mouth anesthetic when brought in contact with it, and this led me to investigate the action of this agent on the eye. I have reached the following conclusions:

After a few drops of cocaine hydrochloride (I used a 2 per cent watery solution of cocaine in my experiments) are applied to the cornea of a rabbit or a dog, or after the solution is instilled into the conjunctival sac in the usual manner, a stage of irritation develops which generally lasts fom one-half to one minute, as shown by the contraction of the eyelids, and the cornea and the conjunctiva of the eyeball become insensitive to contact. All reflexes which usually develop on touching the cornea, such as closure of the lid, eversion of the eyeball and drawing back of the head, are eliminated. Insensitiveness is complete and lasts ten minutes. During this time the cornea can be scratched with a needle, punctured or cauterized with silver nitrate until it becomes white, or deep incisions can be made without the animal reacting in any way. Not until the aqueous escapes or the iris is touched is there a sensation of pain. Whether additional drops of cocaine hydrochloride applied after a corneal section or cocaine administered by some other procedure will also produce anesthesia of the iris has not been investigated on account of the difficulties of examining sensation in animals. In my experiments with animals I found that when the anesthesia ceases there exists a moderate and not always well pronounced dilatation of the pupil.

As these experiments on animals succeeded, I tried the action of cocaine on myself and on a colleague, with the following results: The

immediate effect of the instillation of 1 or 2 drops of a 2 per cent solution of cocaine was a moderate burning which lasted for one-half minute and was succeeded by a feeling of dryness. The palpebral fissure appeared wider than that of the untreated eye. If the cornea or the conjunctiva of the eyeball was touched with the head of a pin one or two minutes after beginning the experiment, this contact was appreciated only to the slightest degree. When the sensation and the reflexes were not completely exhausted, this effect could be obtained by the instillation of additional drops of cocaine hydrochloride. A depression could be produced in the cornea by pressure on the conjunctiva, or the eyeball could be grasped with the forceps without producing any sensation whatever.

The stage of anesthesia lasted ten minutes. This was followed by a weakened sensitivity, which was lost after several hours. During the period of anesthesia, the function of the eye was in no way disturbed. After twenty or thirty minutes following the instillation, the pupil began to dilate. The dilatation increased during the course of an hour to a moderate grade; in the second hour it gradually disappeared, and after several more hours (up to twelve hours) was entirely overcome. During this entire period the pupil reacted promptly to light and to convergence. The weakness of accommodation disappeared earlier than the difference in the size of the pupil. I have not had any opportunity to perform experiments on diseased eyes, though I could convince myself that the anesthetic action of cocaine also took place in animals in which I had produced keratitis by the introduction of a foreign body.

Perhaps it is not too bold to hope that cocaine can be used with success as an anesthetic in the removal of foreign bodies from the cornea as well as in more extensive operations, or as a narcotic in diseases of the cornea and conjunctiva. As I performed these experiments only during the past two weeks, I shall have to take up in a later publication the work which has previously been done on this subject.

Vienna, beginning of September 1884.

INFLUENCE OF FIXATION ON THE VISUAL ACUITY

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In ordinary use the eyes are never entirely at rest but are continually moving. The visual axes are constantly changing so that images of objects in the outside world are brought to lie on the macular region of each eye. In this way objects in the external world are seen in much the same manner as one feels the character of a surface by palpating it with a finger. By moving the finger over the surface the sensory endings of touch are stimulated to send up their message to the brain.

In order to discriminate the finer details of an object, on the other hand, it has often been assumed that the image of an object must rest on the fovea, permitting the parts of the image to stimulate a definite pattern of cones. The term fixation is used in this connection to signify that under these conditions the eye remains still.

This conception of fixation has been strengthened by the close correspondence between the size of the cones in the fovea and the threshold for the acuity of vision as measured by the minimum separable. The cones in the fovea have been found by histologists to have a diameter of from 30 to 60 seconds of arc, and physiologists are agreed that the threshold for the detection of two black dots on a white background is about 60 seconds of arc. No thresholds have been reported for this discrimination lower than the angular distance corresponding to the diameter of a foveal cone.

It is evident that two black dots can be distinguished when their distance apart is just great enough that their images will fall on two foveal cones with a third unstimulated cone lying between them; i. e., 1 minute of arc. The eye must remain perfectly still during the period of fixation in order to obtain such an exact alinement of images that they do not touch at any time the intermediate unstimulated cone.

Aided by a grant from the Faculty Research Committee.

Read before the Eye Section, New York Academy of Medicine, New York, April 16, 1934.

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It was on this basis that test letters were first constructed for determining visual acuity. One [1] of us has pointed out in the recent Wilmer Birthday Volume of the ARCHIVES OF OPHTHALMOLOGY that there is no fundamental physiologic basis for the use of the 1 minute angle in the construction of these letters, however useful it may be from a practical point of view.

Although the threshold for the minimum separable is never lower than about 60 seconds of arc, the threshold for the detection of a displacement in one part of a straight line is found to be considerably lower than this.[2] A break in a straight line may be detected under an angular displacement of 10 seconds of arc by a trained observer, and as low as 3 seconds of arc has been reported. Such displacements are far below the size of the cones in the fovea. In spite of this, we find in the literature frequent attempts to explain such low thresholds on the basis of an image fixed on the foveal cones, stimulating a pattern corresponding to the image.

Hering [3] was the first to appreciate fully the fact that fixed patterns of this sort on the retina are not possible, and that if they did exist one would, in fact, not see a straight line as a complete straight line but as broken and irregular, for the cones are not arranged in strict geometric fashion nor are they truly hexagonal as sometimes pictured. He was the first to recognize that "a straight line is in reality a percept 'idealized' from the retinal image, and that due to constant eye movements the relative spatial value of the individual linear elements fluctuate back and forth within narrow limits about a mean."

Anderson and Weymouth [4] and later Averill and Weymouth [5] were the first to utilize the concept of a constantly moving retinal image to explain the low threshold values for the detection of a break in a line. They were also the first to test this theory experimentally.

In brief, their theory is that the image of a straight line does not rest on a fixed pattern of foveal cones, but is carried back and forth over an area of the fovea by constant slight eye movements, even during the most exact fixation. The result is that a large number of cones are stimulated. They argued that this results in a large number of successive stimulus patterns which are averaged, forming a percept which is much more exact than would be possible if only a few cones

1. Adler, F. H.: Problems in Physiology of Visual Acuity, Arch. Ophth. **11**: 6 (Jan.) 1934.

2. For further discussion see Adler, F. H.: Clinical Physiology of the Eye, New York, The Macmillan Company, 1933, p. 129.

3. Hering, E.: Concerning the Limits of Visual Acuity, Ber. d. math.-phys. Kl. d. K. Sachs. Gesellsch. d. Wissensch. zu Leipzig, 1899, p. 18.

4. Anderson and Weymouth: Am. J. Physiol. **64**:561, 1923.

5. Averill and Weymouth: J. Comp. Psychol. **5**:147, 1925.

were stimulated, in much the same way that the average of a large series of measurements is more accurate, even though less carefully done, than a few very carefully performed ones.

This theory becomes more attractive the more one considers certain facts in the physiology of the retina. It is only necessary to mention the fact that sensory adaptation of the retina and after-images would materially interfere with the fineness of perception if the retinal image were to remain fixed for any period of time on a few sensory elements. The theory assumes that the eye must be in constant motion even during the most exact fixation.

Although the nature of fixation has been the subject of a number of investigations the data in the literature are not satisfactory from an experimental point of view.[6] Most of the records of eye movements concern the large deviations which occur as the eyes are moved over a line of print, or the movements were measured as seen through a microscope when the eyes were held as still as possible without any fixation object to stimulate interest. In addition to this the experimental proof of their theory offered by Averill and Weymouth is not entirely convincing. They find, for example, that their thresholds are considerably lower if the time of exposure of their test object is reduced to a point sufficient to eliminate the effect of any eye movements. However, by reducing the time of exposure of the test object to this degree they are not far from the threshold for perception of the pattern. If the time of exposure were reduced still further the subject would become aware of a flash of light only. Further, their method of assuring fixation for exposures of such short duration was quite inadequate, and with such short exposures, as we subsequently found, fixation takes a long time.

For these reasons it was decided to reinvestigate the following problems:

1. How accurate is fixation when a constant pattern such as a cross-hair on a white background is looked at?

2. How accurate is fixation when a displacement in a part of a line is being examined?

METHODS

The right eye of a subject was anesthetized with 3 drops of p-n-butylaminobenzoyl-dimethylamino-ethanol hydrochloride. This drug has no effect on the size of the pupil, does not dry the cornea or cause any demonstrable change in the epithelium which might dim vision, and has no effect on accommodation.

The subject was then seated comfortably in a chair with the head in a chin-forehead rest facing a test object at 2 meters' distance illuminated by suitably screened lamps. A small plane mirror was then placed on the eyeball at the

6. For a review of the literature on this subject see Duke-Elder, W. Stewart: Text Book of Ophthalmology, London, Henry Kimpton, 1932, vol. 1, p. 577.

temporal limbus. The mirrors used were the thinnest silvered mirrors obtainable and were about 3 mm. in diameter. They adhered to the limbus perfectly. In order to prevent an uncontrolled lid closure the middle finger of the subject's left hand held his upper lid gently, but without causing any pressure on the globe.

The light from a ribbon filament lamp was allowed to pass through a vertical slit whose width could be varied. The light then passed through a convex lens and fell onto the mirror on the subject's eye. The lens was of such a strength that the conjugate image of the vertical slit was focused on the moving bromide paper in an electrocardiographic camera, 1,500 mm. from the eye. A suitable time signal also recorded fifths of seconds on the film. A second signal was installed in some

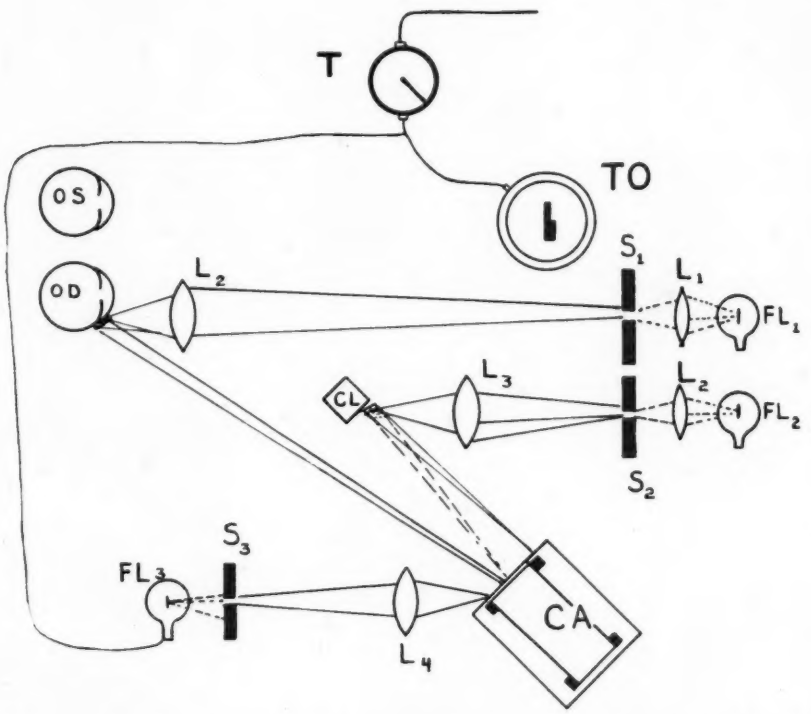

Fig. 1.—Arrangements for the fixation experiments. In the diagram *OD* is the right eye; *OS*, the left eye; L_1, L_2, L_3 and L_4, convex lenses for focusing slit; FL_1, FL_2 and FL_3, ribbon filament lamps; S_1, S_2 and S_3, variable slits; *CL*, a clock with mirror attached for recording fifths of seconds on the record; *CA*, an electrocardiographic camera; *TO*, the test object; *T*, a timing device for intermittent illumination of test object.

of the experiments to record the times of exposure of the test object. This signal was connected in parallel with the current which illuminated the test object.

In every instance before an experiment was run a control record was taken, in which the same mirror was fastened to an artificial eye held in the head holder.

In all the experiments to be reported in this paper, only horizontal movements of the eye are recorded. The apparatus is so arranged, however, that vertical eye movements can also be recorded at will, and these will be reported at a later date.

ANALYSIS OF RECORDS

1. FIXATION WHEN A CONSTANT PATTERN SUCH AS A CROSS-HAIR IS LOOKED AT

Figure 2 *A* shows a monocular fixation of a cross-hair on a white background for a period of slightly over 3 seconds. Each fixation is seen to consist of three types of movements in the horizontal plane.

(*a*) *Rapid Shifts.*—These occur in spite of every effort at fixation, although the subject is aware of their presence, and they increase with fatigue and with lag of attention.

The shifts usually occur about one a second, although in this part of the record they are much farther apart than usual. In none of the subsequent records were two rapid shifts as far apart as 3 seconds. On nearly all the records, as the eye fixes, there is a gradual sliding out of the visual axis to the subject's right, and these shifts seem to

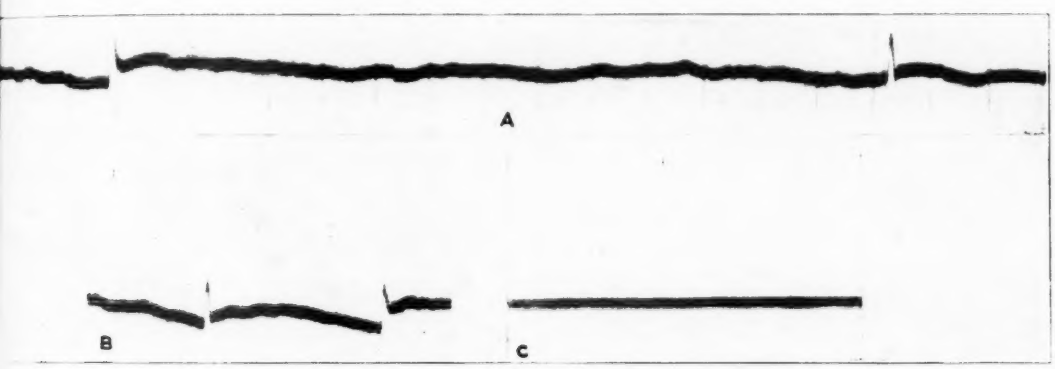

Fig. 2.—*A*, steady fixation of a cross-hair. The time intervals shown are fifths of seconds. *B*, another section of the record in the same experiment. *C*, control record (of an artificial eye) taken before the experiment.

represent a corrective movement to the left, for the eye nearly always swings farther in this direction than the subsequent return to the right.

In the whole record, only part of which is shown in the illustration, there were seven shifts. These averaged 7 mm. to the left and 5 mm. to the right. Assuming the axial length of the eyeball to be 24 mm. and the center of rotation to be 13 mm. behind the cornea, we find that a point on the retina must have moved during these shifts 0.056 mm. to the right and 0.040 mm. to the left (17 minutes and 31 seconds to the right, 12 minutes and 29 seconds to the left).

(*b*) *Waves.*—These are inconstant in direction, extent and duration, but lie on a straight line which gradually moves toward the right. The compensatory shifts bring the visual axis back to its original position. The waves measure from 1 to 2 mm. from the top to the bottom of the trough. This corresponds to a displacement of from 0.008 to

0.016 mm. (from 2 minutes and 29 seconds to 4 minutes and 58 seconds). Each wave lasts less than 0.2 second.

(*c*) *Fine Vibratory Movements.*—These are small trembling movements averaging in number from five to ten in 0.1 second. They are not seen in the control records (fig. 2*C*), and are not, therefore, of mechanical origin. They probably represent the vibration frequency of the extra-ocular muscles. If the mirror attached to the artificial eye is gently tapped when a control record is being taken the resulting record shows vibrations, but these have a much slower and more regular period than the ones we have just described. These cannot be due, therefore, to the vibration frequency of the mirror. The average difference between the length of these vibrations and the control record is 0.9 mm. This represents a movement of a point on the retina of 0.0072 mm. (2 minutes and 14 seconds).

Summary.—From an analysis of these records it is evident that when the eye is strenuously fixing a stationary cross-hair, which has been found by experiment to be the best test object for securing steady fixation, it is not at rest. When it is steadiest a point image would be moving back and forth over the retina an angular distance of over 2 minutes. The diameter of the foveal cones, as stated, has been variously set by histologists as ranging from 30 to 60 seconds of arc. Hence, a point image during the fixation described must have moved back and forth over from two to four cones at least. (Because of the impossibility of photographing the extreme limits of each excursion of the mirror all the figures are underestimates rather than overestimates.)

These finer movements occur very rapidly. Each consumes only from 0.01 to 0.02 second. On top of these are the wavelike movements, which, if we assume the foveal cones to be an average of 40 seconds of arc in diameter, must carry a point image over from five to ten cones. To this motion must be added the gradual deviation of the visual axis to the right, which, in the case of the first record shown, amounted to 3.4 mm. in the first second following the initial rapid shift. In this second the point image would have deviated 8 minutes and 42 seconds, or a distance covering about thirteen cones. About every second or so the eye makes a rapid readjustment which must cover at least twenty-six cones.

2. FIXATION WHEN A BROKEN LINE IS LOOKED AT

In place of the cross-hair the subject was shown a horizontal black slit on a white background. This slit was composed of two halves, each of which could be enlarged or narrowed at will by a micrometer screw. Hence, it was possible to change gradually the width of one half of the slit without the subject knowing which half was being altered. By means of an appropriate timing device the light on the test object was switched on and off at regular intervals. The light was on

for 0.8 second and off for 0.9 second. Each time the light was turned off after the initial exposure one half of the slit was gradually widened by turning one micrometer screw a definite amount. At each dark period this was repeated, until the subject could tell that one side was wider than the other, and which side had been widened.

During the exposures recorded in figure 3 *A* the subject could not tell which side of the slit was being widened. As would be expected,

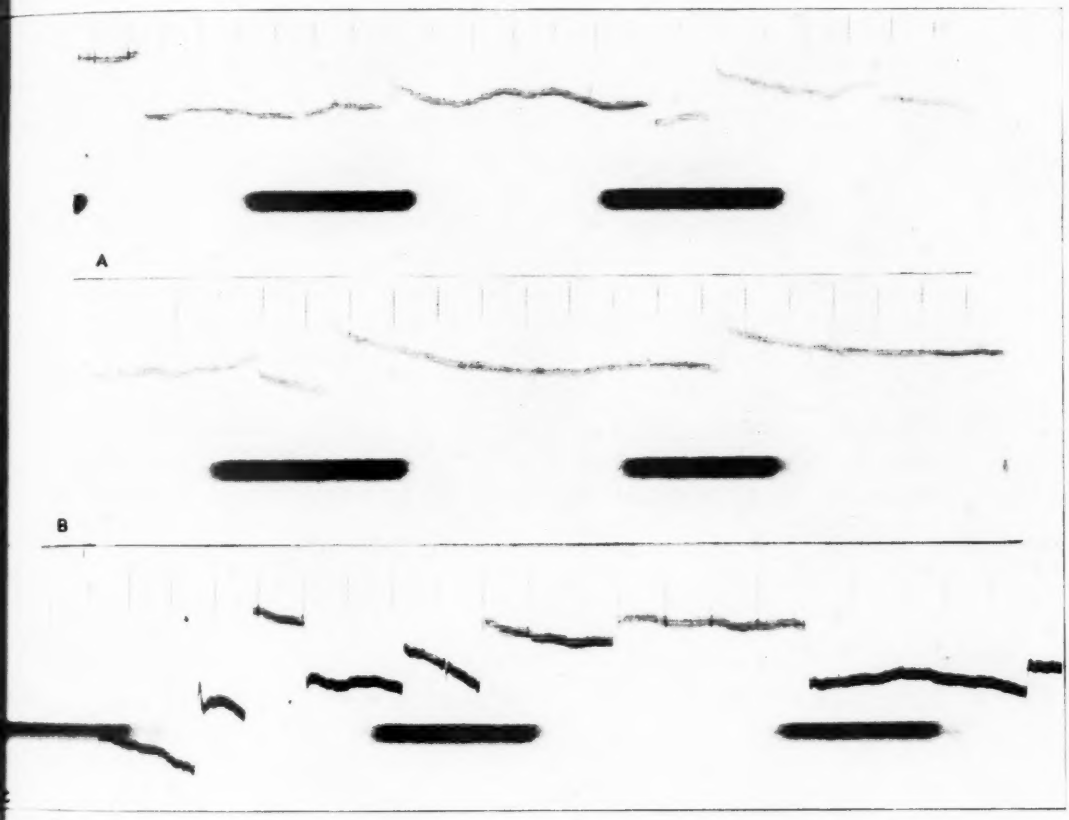

Fig. 3.—*A*, intermittent exposure of a widening slit. Exposures of test object occur between the black signal marks on the record. During each dark period the left slit was gradually widened. Notice the two large shifts during the exposures of the test object and the waves. At this point in the experiment the subject cannot tell any difference between the two limbs of the slit. *B*. At this point the subject recognizes the difference in width of the slits. Notice that now there are no large shifts during the exposure periods and the waves are smaller. *C*, binocular fixation of a variable horizontal slit with intermittent illumination. The test object is exposed for the first time at the left of the record. The subject is unable to fixate the test object properly during the first second.

every time the light went on a readjustment of the visual axis had to take place, for during the second in the dark the test could not be accurately fixated. However, the record shows that even when the

light was turned on there were large shifts and the wavelike movements were exaggerated.

On the other hand, when the difference in width became recognizable (fig. 3 *B*), the motion subsided somewhat. There were no longer any large shifts during the period of exposure of the test object, although these still took place in the dark periods. One also got the impression that the waves were not so extensive. No difference could be made out in the small vibratory movements in the two records.

Summary.—As the difference in the width of the two parts of the slit became recognizable to the subject his eyes did not move to such an extent as previously.

3. BINOCULAR FIXATION OF A VARIABLE HORIZONTAL SLIT

Exposures were intermittent. Figure 3 *C* shows that when the test object was exposed for the first time fixation was very poorly controlled for at least 0.6 second. At the next exposure fixation was much improved. When the slit was sufficiently widened for the subject to recognize that it had been widened the fixation became steadier. No difference was noted in subsequent exposures of the horizontal slit.

When records were taken of monocular fixation of a variable horizontal slit under steady illumination, we could find no change from the type of movements shown when a cross-hair was fixated. The large shifts, waves and vibratory movements were of about the same magnitude and occurred at about the same frequency.

CONCLUSIONS

Fixation is a relative term. Even during the most exact fixation of the visual axes the eyes are in continual motion, so that a point image must traverse at least from two to four cones in the fovea. Even this degree of fixation does not last more than 0.2 second, for, owing to constant tonic impulses to the extra-ocular or cervical muscles, the eyes or the whole head show slight rhythmic deviations which must carry a point image over ten to fifteen cones in a second. Added to this are large movements of which the subject is conscious when he is making a strenuous effort at steadiness and which he cannot prevent, which carry the image over at least twenty-five cones.

One can say with confidence that fixation is certainly limited to the true fovea centralis. The conception of the thresholds of visual acuity must be based on some theory which treats of the fovea acting as a whole, and not on the discrete stimulation of single individual cones or fractions of cones, as has sometimes been attempted. These experiments do not give any support to the theories of Weymouth and his co-workers, but are compatible with those theories.

It seems firmly established that the eyes are in constant motion, and perhaps the purpose of this is to carry the image over a relatively large number of cones in the fovea.

If this is correct, one may apply this reasoning to those cases of congenitally defective foveas in which the eyes show marked searching movements during fixation. It is well known that in these cases the eyes move constantly and through a fairly wide angle when the patients attempt to see details. The explanation which has generally been offered to account for this is that the fovea, being defective, does not impart any special clarity to the image when it comes to lie on this portion of the retina. The eye is allowed to swing the image past the fovea therefore until, as the image reaches the periphery of the retina, the fall in acuity is sufficient to halt further motion. The process is then repeated.

According to the conception of motion of the visual axes which is given in the foregoing paragraphs, it is plausible to interpret this in another way. If the normal person has to have the image in constant motion on the fovea, where the cones are closely packed together and therefore numerous, it is all the more necessary to increase this motion when the fovea is defective, so that the image will sweep over a similar number of cones in those regions where the cones are more sparsely scattered. Hence, the patients with congenitally defective foveas show these rapid searching movements for the purpose of having a large number of cones stimulated. If the fovea becomes defective in later life, however, this corrective mechanism cannot be employed because the patient has already formed the habit of keeping the eyes firmly fixed so that the image will fall on the fovea. For this reason the searchng movements are not seen in patients with macular disease acquired later than infancy.

HEMANGIO-ENDOTHELIOMA OF THE ORBIT

REMOVAL THROUGH TRANSCRANIAL APPROACH

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Tumors caused by augmentation in volume of normal vessels or by formation of new vessels occur in the orbit as angiomas of various types, or varicosities, with or without direct arterial communication. Should such tumors become pulsatile because of copious arterial supply or because of juxtaposition to a large artery, they tend to become larger through expansion of existing blood spaces and involvement of contiguous tissue. The bony walls of the orbit may be eroded by the pulsating soft tissue, and bony foramina may become greatly enlarged by pulsating, dilated vessels.

Exophthalmos is the most frequently observed sign of the presence of any orbital tumor, but in the group of vascular tumors it takes on particular significance. Pulsating exophthalmos is usually rapidly progressive and may require ligation of one or more of the carotid arteries. Not all pulsating exophthalmos is due to aneurysm of the cavernous sinus or to rupture of the carotid artery into the great venous spaces. Congenital or acquired angiomas pulsate in a degree varying with the circumstances. The situation of the tumor within the orbit, its confinement by the bony walls, the volume of blood it contains and other factors determine the intensity of pulsation and, in turn, the rate of expansion or growth and the character of erosion of the bone.

Highly vascularized tumors of the orbit result from inflammation or injury, or occur spontaneously. They simulate angioma in rate of growth, situation within the orbit, exophthalmos, effects on vision, slight pulsation and benignity. Bruit and thrill are absent. In this classification are fibromas, endotheliomas and lymphangiomas, a relatively benign group. The poor results seen are due to pressure on the globe and orbit. The lesions involve the retrobulbar structures throughout, extending in directions of least resistance, surrounding muscles and tendons and blood vessels, mingling with fascia and Tenon's capsule. A limiting

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Read before the Section on Ophthalmology at the Eighty-Fifth Annual Session of the American Medical Association, Cleveland, Ohio, June 14, 1934.

membrane is developed over some tumors, separating the neoplastic from the nonneoplastic tissue. Some obtain their blood supply from a single vessel through a pedicle, and others through many vessels that anastomose freely. They contain different proportions of erectile tissue which enlarges on physical strain such as coughing or from holding the head in a dependent position.

From clinical data alone, it sometimes is impossible to identify true angiomas and other highly vascularized tumors. A copious mixture of arterial blood in the large venous spaces may be detected by tests for oxygen and carbon dioxide performed on blood withdrawn through a cannula, a valuable aid in the differential diagnosis of pulsatile tumors. Roentgenograms reveal erosion of bone but do not clearly depict the tough membranes which develop as a protection against expansion of the tumor, and which form important structures that may be utilized in surgical reconstruction after removal of the tumor.

The various methods for treating vascular tumors of the orbit may be grouped on the basis of the principal reasons for the surgical attack, as follows: (1) ligation, (2) compression, (3) radiation, (4) injection and (5) extirpation. The choice of method to adopt in any given case depends on factors that cannot adequately be described here. A combination of any of the conservative methods may be tried before extirpation is attempted. In the event that surgical intervention is attempted, the surgeon should be prepared to ligate a carotid artery if necessary, and should be equipped to deal with sudden and copious hemorrhage. The veins may be fragile and may anastomose freely with other weak-walled, dilated blood spaces that break under the strain of the contained blood when the surrounding supporting tissue has been stripped away, and may prove very difficult to handle.

Some thick-walled arteriolar masses are supplied by vessels several times larger than normal arteries. The foramina of the orbital walls may transmit large vessels that extend beyond the confines of the orbit, and connect with vascular tumors or dilated vessels in the cranial cavity or in the pterygoid fossa. Communication with the angular vein and artery is usually a later development.

Because of the difficulty of adequately controlling hemorrhage in the deeper parts of the orbit, and the impossibility of going beyond the orbital walls to extend the operation as far as may be needed, frontal approach through the eyelids does not provide a sufficiently wide avenue for operative attack. In view of previous experience in the treatment of cerebral meningiomas invading the bone and entering the orbit, and the review of Naffziger's [1] work on the treatment of exophthalmos, we

1. Naffziger, H. C.: Progressive Exophthalmos Following Thyroidectomy: Its Pathology and Treatment, Ann. Surg. **94**:582 (Oct.) 1931.

believed that it would be feasible to remove a moderately large vascular tumor of the orbit by the transcranial approach. The transcranial approach used in the following case proved to be adequate and effective.

REPORT OF A CASE

A girl, aged 12 years, entered the Mayo Clinic Oct. 30, 1933. Slight proptosis of the left eye had first been noticed by her parents when she was 4½ years of age. Slow, gradual progression of the proptosis was observed for several years. During the eighteen months before she came to the clinic, proptosis had increased more rapidly. There were no symptoms of intracranial disturbance or of involvement of extra-orbital structures.

Fig. 1.—Left exophthalmos due to orbital hemangio-endothelioma.

The vision of the right eye was 6/6; that of the left, 6/10—. The left eyelids were swollen, particularly in the temporal portion. The left palpebral fissure was wider than the right, due to protrusion of the globe, which was displaced toward the nose. Exophthalmometer readings by the Hertel method were: right eye, 15; left eye, 26 (fig. 1). Movements of both eyes were good except lateral rotation of the left eye. In the left orbit was a mass of highly vascularized, edematous tissue that yielded to slight pressure, and protruded around the globe on the temporal side. The orbital rim was firm and not eroded. The pupils were normal in size, shape and position; the pupillary reflexes were normal, and the media were clear. The right fundus was normal. The left revealed swelling of 2 diopters in the lower half of the disk; the retinal veins were engorged and tortuous, with formation of loops indicative of resistance to venous flow. Roentgenograms of the head revealed enlargement of the left orbit with erosion of the floor and

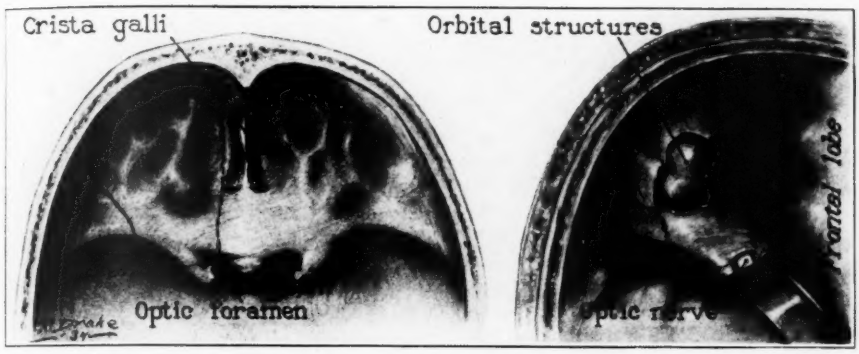

Fig. 2.—*Left:* Outline of proposed orbital decompression. *Right:* Enlargement of burr opening exposing periorbital fascia.

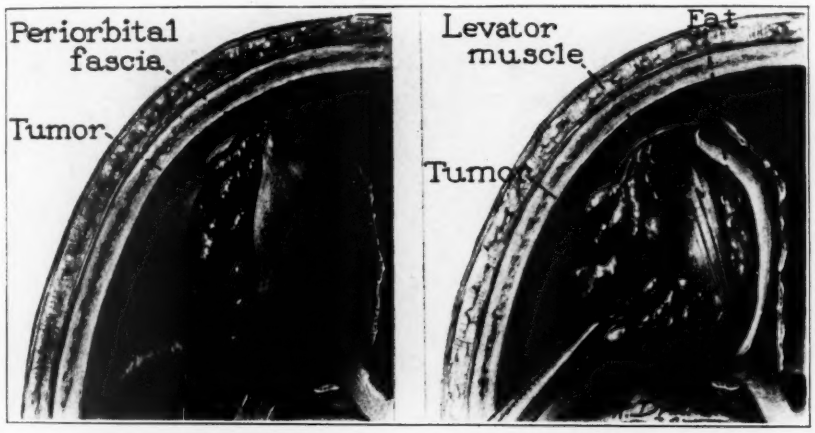

Fig. 3.—*Left:* Decompression of orbital structures, exposing hemangio-endothelioma. *Right:* Elevation of hemangio-endothelioma.

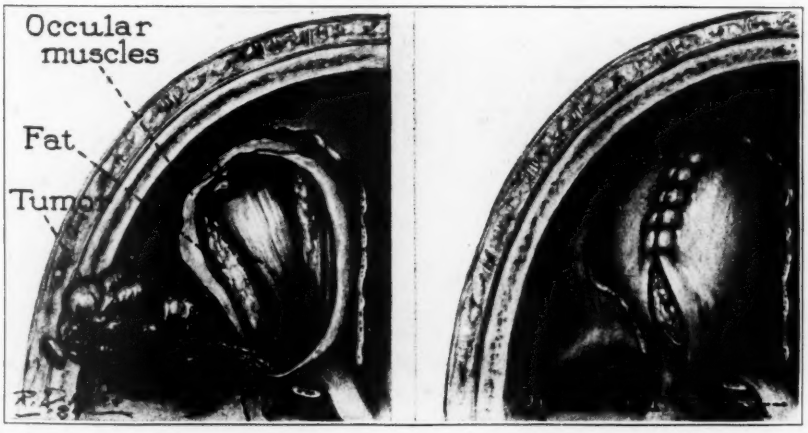

Fig. 4.—*Left:* Delivery of hemangio-endothelioma, with ligation of communicating vessels. *Right:* Closure of periorbital fascia, exposing the optic nerve and structures passing through the sphenoidal fissure.

the lateral wall. There was slight enlargement with some thickening of the margin of the left orbital foramen as compared with that of the right.

On clinical grounds, the diagnosis of hemangioma of the orbit was made. Although there were no definite signs of intracranial extension of the tumor, the erosion of the orbital walls, the enlargement of the optic foramina and the thickening of the margins of the foramina indicated an extensive tumor with a copious

Fig. 5.—Hemangio-endothelioma. The upper part shows the gross specimen, the lower part, a cross-section.

blood supply. In this circumstance, to operate through the orbit without being prepared to follow backward as far as necessary would be dangerous and probably futile.

At operation a left frontal osteoplastic flap of the Frazier type was elevated. The left half of the floor of the anterior fossa was exposed by elevating the dura with the frontal lobe. The dissection was carried posteriorly until the optic nerve and the middle fossa could be seen (fig. 2). The orbit was opened at

the most prominent portion by a burr, after which the roof and a portion of the lateral wall were removed by a rongeur. This allowed the orbital mass to bulge through the opening into the cranial fossa. The mass was covered by a thin, smooth, firm periosteal layer. On incising the periorbita lengthwise along the dorsolateral aspect (fig. 3), the angiomatous mass and retrobulbar fat quickly filled the gap as if they were held under tension.

The tumor was posterior to and over the dorsolateral aspect of the globe. It was oval but flattened as it came in contact with the globe, measuring 4 or 5 cm. in the anteroposterior axis and 3 cm. at its greatest width. The mass was definitely venous, but contained fibrous strands and nodules due to thrombosed veins. The mass communicated anteriorly with the ophthalmic veins and posteriorly with the veins passing through the sphenoidal fissure and with those communicating

Fig. 6.—Appearance of patient seventeen days after removal of orbital hemangio-endothelioma.

with the sylvian veins. The arterial supply was generous, and the arteries entered the mass from the inferior surface.

Before resection was attempted, the angiomatous body was dissected free from the ocular muscles and fat. The venous connections anteriorly were ligated and divided along Tenon's capsule. The mass was then lifted off the globe and out of the orbit. The small arteries and posterior venous connections were ligated as they were brought into view (fig. 4). The pathologists reported that the tumor was a hemangio-endothelioma (fig. 5).

In closing the wound the periorbita was sutured about the orbital fat. A plate for support of the frontal lobe was not introduced, although we believe it would be an advisable procedure in similar operations in order to avoid transmission of cerebral pulsations to the globe and to prevent the weight of the frontal lobe pressing on the orbital structures. Since the dura was not opened and scar tissue

is sure to develop, an artificial support or bridge may not be necessary. The bone flap was replaced and fixed by two silk sutures threaded through gimlet openings placed opposite each other in the skull and flap. The scalp was closed by interrupted sutures in the galea and skin.

On observing the left eye immediately after the operation it was apparent that the exophthalmos had been converted into enophthalmos. Cerebral pulsations were definitely transmitted to the globe. Forty-eight hours later the eyeball had been pushed slightly forward beyond normal limits, but the cerebral pulsations were barely perceptible. The left external rectus muscle still remained paralyzed. Two weeks after operation, on the date of the patient's dismissal from the clinic, the left eye still remained slightly proptosed, but it was not as prominent as it had been forty-eight hours after operation (fig. 6). Cerebral pulsations were barely perceptible, the partial palsy of the left sixth nerve still remained, and convalescence otherwise was normal.

The father reported, six months after operation, that his daughter had convalesced satisfactorily, and that she could use the eye but still had difficulty in rotating it outward. His only concern was about weakness of the left sixth cranial nerve; he made no comment about ocular pulsations, exophthalmos or enophthalmos.

COMMENT

The ease with which the hemangio-endothelioma was removed suggests many possibilities for the transcranial approach to vascular and neoplastic lesions situated in the retrobulbar space of the orbit.

DISCUSSION

Dr. Edmund B. Spaeth, Philadelphia: This discussion centers itself largely about the type of approach used for the removal of an orbital neoplasm. The precedent for a similar surgical attack has been established. Frazier (Frazier, Charles H.: Unilateral Exophthalmos, S. Clin. North America **3**:281 [Feb.] 1932) reported the surgical treatment of unilateral exophthalmos in 5 cases. After having had the maxillary antrum and the ethmoidal labyrinth explored with negative results, he did an exploratory intracranial operation, transfrontal and superior to the left frontal sinus. The cerebral cavity was examined extradurally as far posterior as the cribiform plate. In view of the later progress of the condition, he considered the diagnosis to be cavernous sinus thrombosis.

Dandy (Dandy, Walter E.: Prechiasmal Intracranial Tumors of the Optic Nerves, Am. J. Ophth. **5**:169 [March] 1922), reporting on two cases of prechiasmal intracranial tumors (endotheliomas) of the optic nerves, described the advance of the tumor masses as they passed through the two optic foramina into the orbits. In one case in which a craniotomy of the right side was done, the removal of the orbital portion of the tumor, as it embraced the optic nerve, demanded the resection of a part of the superior roof of the orbit. In this case opening the roof of the orbit did not mean that elevated portion of the anterior fossa which forms the domed central portion of the orbital roof, but consisted only in breaking down and enlarging the orbital foramen and the contiguous roof at its posterior superior portion. Some time later he advocated this technic as a possibility—not only for tumors extending from the cranial cavity into the orbit, but also "for tumors arising in the orbit and extending into the cranial chamber."

It is most interesting that Dandy should have had another experience with somewhat similar surgical intervention in a case of pulsating unilateral exophthalmos, which, at operation, proved to be due to an encephalocele. The same type of approach was used as by Benedict and Adson. Surgery confirmed the roentgenographic diagnosis of a large bony defect involving the major portion of the roof of the orbit, the defect being bridged over by rather flaccid periosteum (Dandy, Walter E.: An Operative Treatment for Certain Cases of Meningocele [or Encephalocele] into the Orbit, Arch. Ophth. **2**:123 [Aug.] 1929).

A second factor of great importance is the consideration of this technic of surgical approach as compared with the better known, though I believe no less difficult, Krönlein method. In 1901 Byers (Byers, W. G. M.: Primary Intradural Tumors of the Optic Nerve, *Bull. Roy. Victoria Hosp., Montreal* **1**:3, 1901) analyzed a series of 102 intracranial cases, and in 1910 Hudson, a series of 182 cases. Of these, in 23 postmortem examinations which were obtained in cases of intra-orbital growths, 21 showed the simultaneous presence of an intracranial growth. Fourteen of these autopsies were obtained on persons who had died of meningitis only a few days after the removal of the intra-orbital growths; so it is certain that the intracranial complication was present at the time of the orbital operation. An exploratory operation as in the essayists' case might have uncovered such a complication, but with the Krönlein operation such an opportunity was quite out of the question. This is a factor which should be seriously contemplated.

Still another point applies especially to the case which Benedict and Adson have presented, i. e., to a vascular tumor. It is not of equal importance in all the possible cases. I am indebted to Francis C. Grant (personal communication to the speaker, June 1934) for calling my attention to this point.

In opening the orbit, by means of Krönlein's technic, one finds the eyeball in front of the field of operation at all times, inaccessible to and at a great distance from the large vessels at the apex of the orbit—especially the carotid. A lesion lying on the medial side of the optic nerve or the eyeball is difficult to remove. With the transfrontal approach to the orbit, as described here, the eyeball is below and in front of the osteotomy. Bleeding, especially in vascular neoplasms, can be controlled only with great difficulty when using the Krönlein operation, but with the frontal osteoplastic flap, one has a direct view of the carotid, and if dangerous bleeding should develop, ligation of the carotid would be a relatively simple procedure. When one remembers that the case presented was one of a vascular neoplasm, difficult to remove under the best of circumstances, then does that of which I have just spoken assume greater significance for the operator's surgical judgment.

Dr. C. S. O'Brien, Iowa City: Within the past few months we have seen, at the University of Iowa, 2 cases of cavernous hemangioma of the orbit. In both the tumor was visible under the upper fornix extending backward into the orbit. In 1 case the bluish aspect of the tumor disappeared following the use of radium, and at operation there was practically no hemorrhage. I was very much astounded at the lack of bleeding but went ahead, expecting every minute to cut into a vessel which would give rise to profuse hemorrhage. As the operation progressed no such vessel was encountered, and the tumor was removed with the loss of little blood. Microscopic examination of the tissue revealed advanced vascular sclerosis and much fibrosis. Evidently the radium had produced sclerosis of the vessels feeding the tumor. Recently another similar case was seen. In the upper portion of the orbit there is an angioma which is being treated with

radium as a preliminary measure and which is becoming paler and less bluish. I am not absolutely sure as to what is happening to these tumors, but apparently there is a vascular sclerosis. Perhaps preliminary treatment with radium over a period of a few weeks will allow us to remove such hemangiomas with little or no hemorrhage.

Dr. William L. Benedict, Rochester, Minn.: I am very grateful to Dr. Spaeth and Dr. O'Brien for their additional remarks. Dr. Spaeth has called attention to the previously reported surgical methods which are designed to produce practically the same results. The main reason for our reporting this, however, was to bring out two factors: First, that the pulsatile tumor does not always represent an arteriovenous aneurysm. Any vascular tumor that has a comparatively large blood supply pulsates, and the pulsation does not mean that there is an arteriovenous aneurysm. Therefore the differentiation of pulsatile tumors and cavernous angiomas must be borne in mind. Furthermore, one should bear in mind the distinct pathologic difference between the cavernous angioma, the so-called cavernoma, which has thin-walled blood spaces, and the hemangio-endothelioma, which is largely composed of proliferating vascular tissue containing a large number of comparatively small vessels, but which, in the aggregate, may contain a large quantity of blood.

There are traumatic cases, such, for instance, as that of a boy who had a bullet pass through the superior nasal angle of the orbit and lodge in the petrous bone. He had a large, pulsating cavernoma; the anastomosing vessels were very fragile, and back of any hemostat that we might put on to control the hemorrhage the wall would break. In one case the orbit had to be packed very firmly to control the hemorrhage. In another case, a young boy fell on a pitchfork, and within ten minutes the eyelids were tremendously swollen and blackened. Those are instances of angioma of the cavernous type, which is much more likely to be followed by severe hemorrhage than one of the endothelioma type, but the difficulty in differentiating them on the basis of clinical data makes it imperative that one be conservative and be prepared to ligate the larger vessels supplying this region, if necessary.

Dr. O'Brien spoke of the use of radium. This is exactly in accord with our own thought, and in commenting on the five methods of treatment of this type of tumor I mentioned removal or extirpation as last. Radiation is useful; even though it does not reduce the size of the tumor in all cases, it will reduce the size of the tumor in many of them, and in many cases angioma of the orbit will not need to be operated on if radium is properly applied.

Furthermore, coagulation may be employed and, particularly in dealing with the traumatic cavernoma, a gelatinous or sclerosing solution may be injected directly into the vessels, bringing about thrombosis. This treatment, however, is not without some hazard. Finally, extirpation must be resorted to if other methods are not effective.

Dr. Alfred W. Adson, Rochester, Minn.: I am afraid that Dr. Spaeth got the wrong idea with reference to this technic. It was not my intention to include in this discussion a review of the history of the approaches to brain tumors which extend into the orbit or into the various sinuses but to report a typical ophthalmologic case without brain or meningeal involvement. We were not attempting to claim priority on any particular approach but rather to call attention to the usefulness of the transcranial approach in the management and removal of a hemangio-endothelioma situated in the orbit posterior to the globe.

REPAIR AND RESTORATION OF THE EYE SOCKET

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AND
GEORGE WARREN PIERCE, M.D.
SAN FRANCISCO

The normal function of the eye socket depends on the complete intact presence of its lining membrane, the conjunctiva. The eye socket is no exception to the surgical dictum that every cavity and hollow viscus of the body must have a lining; therefore, total or partial destruction of this conjunctival lining obliterates or distorts the socket, rendering it incapable of carrying a glass prosthesis.

These statements do not hold true for such rare conditions as postconjunctival tumors, large foreign bodies or muscular hyperplasia as found in exophthalmos. It is readily conceded that the mere bulk found in these conditions, in spite of an intact lining, so crowds the orbital cavity that a glass eye cannot be worn unless the offending cause is removed. This was forcibly demonstrated to us recently in a rather unique condition (case 2). Following the accidental loss of an eye, the patient was unable to wear a glass prosthesis. Examination of the socket revealed an intact overabundant conjunctiva, but considerable postconjunctival bulk. Because of slight proptosis of the other eye and a history of two thyroidectomies for thyrotoxicosis, a diagnosis of hypertrophy of the ocular muscle, associated with thyroid disease was made, and this diagnosis was confirmed at operation. Removal of a sufficient amount of the hyperplastic muscle resulted in return of the socket to a functioning condition.

In restoration of the eye socket there are several basic principles of reconstructive surgery that must be strictly adhered to if successful end-results are to be obtained. They are: (1) excision of all scar tissue, (2) overcorrection of the existing defect by one half, (3) immediate epithelization of the denuded areas and (4) immediate and continuous distention of the newly lined cavity.

In the smaller defects of the mucous membrane of the socket, when there are scars causing adhesions between the eyelids and socket or between areas of the socket itself, corrections can be readily effected in a simple manner. Excision of the scars, wide undermining of the adjacent edges and the restoration of the contour of the socket with

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appropriate flaps of mucous membrane will restore the lining membrane to normal.

In the larger defects, when considerable mucous membrane has been replaced by scar tissue and adhesions, more radical procedures are necessary. The scar tissue must be excised from the interior of the socket and from the posterior aspect of the eyelids, if these are markedly involved. This removes all adhesions and contractures and establishes the original defect within the orbital cavity, thus permitting direct calculation of the amount of material needed to reline the cavity. Thin Ollier-Thiersch grafts are the most appropriate material to use for orbital epithelization, but it must be remembered that these grafts undergo marked contraction after being placed in situ, so that a 50 per cent overcorrection of the original defect must be made to compensate for the eventual contraction.

Fig. 1 (case 1).—*A*, marked contraction of the orbital socket, caused by traumatic loss of the right eye and lining membrane. *B*, eye socket lined with Ollier-Thiersch graft and glass prosthesis in position; the fulness of the upper lid and the equality of the orbital fissures should be noted.

The manner and amount of exposure of the orbital socket are extremely important. Dissection of the lower eyelid should be carried down to the infra-orbital ridge, keeping well behind the orbicularis oculi muscle and the lower margin of the rim. This dissection should start about ⅛ inch (0.32 cm.) posterior to the cilia and proceed inferiorly at a gentle slope until the infra-orbital ridge is encountered. The periosteum of the infra-orbital ridge should be exposed for ¼ inch (0.64 cm.) throughout its length. This creates a deep socket of the same general curvature as the normal lining, with normal thickness of the eyelid and a margin of the eyelid that will have less tendency to ectropion or medial puckering. The opening of the orbital cavity behind the medial and lateral canthi should be carried to the respective orbital walls, exposing the periosteum, as was done along the infra-orbital ridge.

Dissection of the upper eyelid posterior to the tarsal plate should be carried superiorly in midline to the levator palpebrae muscle, continuing onto the lateral and medial aspects of this muscle for another ½ inch (1.27 cm.). This lateral extension compensates for contractures that will occur. It has the further advantages of permitting the glass pros-

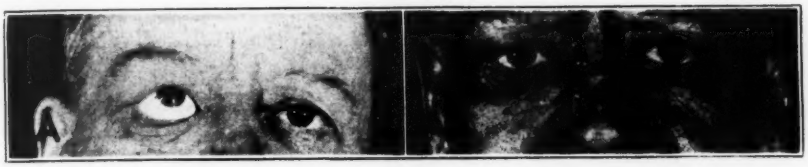

Fig. 2 (case 2).—*A*, marked protrusion of the glass prosthesis, caused by hypertrophied ocular muscles. *B*, normal socket for the glass prosthesis, recreated by subconjunctival excision of the hypertrophied ocular muscles.

Fig. 3 (case 3).—*A*, complete symblepharon following a burn of the right eye with hot metal; the lids firmly adhered together at the margins of the rim and completely adhered to the injured globe. *B*, complete freeing of all adhesions between the lids and the globe, the denuded lids and globe being grafted with Ollier-Thiersch grafts; a shell eye is being worn over the patient's own globe.

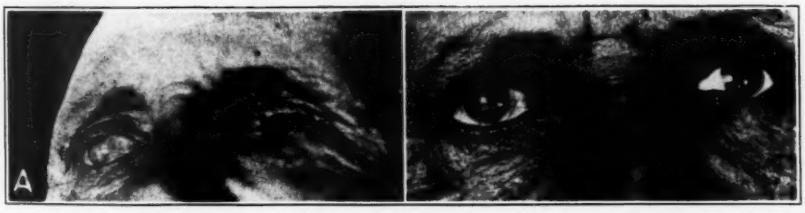

Fig. 4 (case 4).—*A*, injury to the right eye and loss of left eye following an explosion of dynamite; marked laceration of the left lower lid, with loss of its middle third, is seen. *B*, a Tripier flap from the upper lid was used to line the lower lid, and rotating skin flaps were used for covering the lower lid; an external canthotomy was planned to improve the cosmetic result further.

thesis to ride higher behind the upper lid, thus preserving the fulness of the normal upper lid that is so strikingly lacking in the great majority of sockets carrying a prosthesis.

The depth of the socket at all points should be from ½ to ¾ inch (1.27 to 1.91 cm.), but in creating this defect particular emphasis must be placed on preservation of as much of the remaining ocular muscles as possible to obtain the maximum amount of motion of the glass eye.

Following complete dissection of the new socket, an accurate impression of the defect is made in one piece with Stent dental modeling com-

Fig. 5 (case 5).—*A*, marked loss of lining membrane of the eye socket following removal of the eye for injury. *B*, result after excision of the scar and after lining of the eye socket with a single Ollier-Thiersch graft.

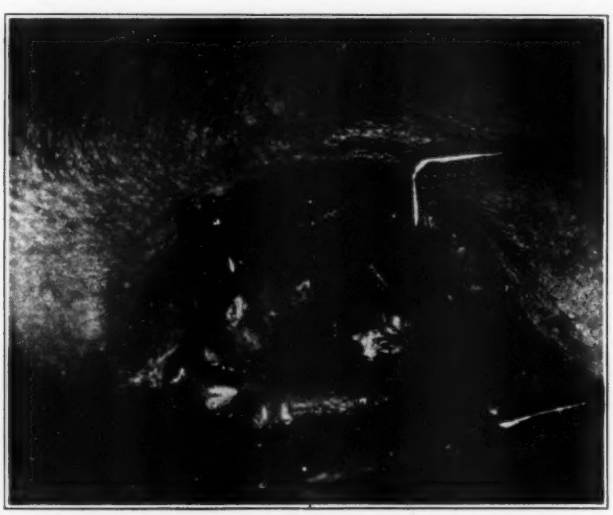

Fig. 6 (case 6).—Typical reconstructed socket. The dark area in the center is all that remains of the old mucosa; the remainder of socket was grafted. The position of the retractor shows the depth of the upper and lower sulcus.

pound. The model is covered with a thin Ollier-Thiersch graft, with the surface of the skin facing the model, and sutured into position. The edges of the graft overlap the denuded edge of the defect, and sutures pass in sequence through the skin graft, the edge of the defect, the skin graft, over the stent model, through the skin graft and the edge of the

defect and then again through the skin graft, being tied over the stent "model" at an appropriate tension. This method of suture completely covers the denuded area, but the sutures should not incorporate the external margins of the rim, or necrosis with deformities of the rim due to pressure will supervene.

Fig. 7.—Diagrammatic incisions for pedicle flaps to be used for lining the lid. All the flaps may be used to line the upper or lower lid. Flaps *a*, *b* and *c* are preferred in order.

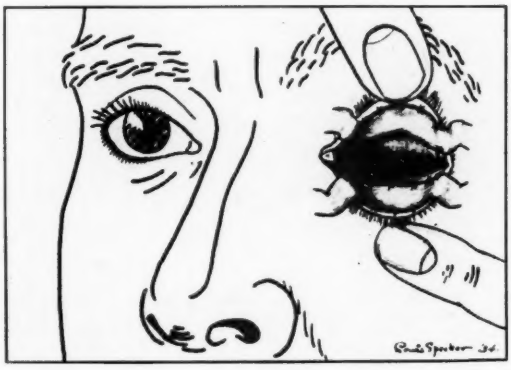

Fig. 8.—Flaps *a* and *b* in position; Ollier-Thiersch grafts to line the remainder of socket are not shown for the purpose of clarity.

The eyelids should be sutured together after the stent model is in position, or, if not, the margins of the rim should be made to meet by the sutures holding the graft in position. This is the position of rest, and when it is properly maintained eventual intra-oribtal shortening is reduced to a minimum. The reconstructed socket is dressed dry, preferably open, with constant daily inspection, and secretions or sutures that are irritating are removed. The stent model is removed within from

seven to ten days, depending on how well it is tolerated, and the skin-lined cavity is thoroughly cleaned with physiologic solution of sodium chloride. The original stent model or its duplicate is immediately replaced in the new cavity. This is most important, as the newly formed eye socket must be continually distended if success is to be assured. Contractures of the socket will continue for varying periods of time, depending on individual reactions, but continual distention, even with a slightly smaller prosthesis, must be rigidly enforced. Selection of a permanent prosthesis should not be made until the maximum amount of shrinkage has occurred. This may require from six to eight weeks or longer, but its occurrence may be judged by the easy replacement and retention of the prosthesis being worn. The eye socket is cleaned daily with hydrogen dioxide and physiologic solution of sodium chloride and lubricated with plain petrolatum, and the glass prosthesis is given its usual care.

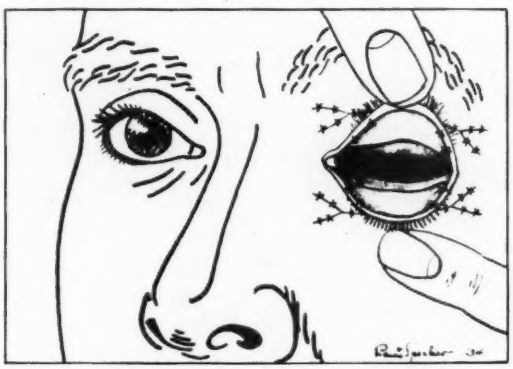

Fig. 9.—Pedicles of flaps severed and returned to bases.

In reconstruction of the total socket, particularly when there has been a lateral decrease in the size of the palpebral fissure, it is necessary to perform external canthotomy. This procedure gives a greater exposure of the orbital defect, increases the lateral dimensions of the palpebral fissure and permits the easy removal of the large molds that hold the Ollier-Thiersch grafts in position.

In grafting the socket no attempt is made to isolate the lacrimal ducts; they are covered with the graft at the time of its application. Later, small blisters with contained lacrimal secretion are to be noted over these ducts. The blisters are punctured with a hot needle, as recommended by Dr. John Wheeler, permitting the outflow of tears. Openings for the lacrimal ducts into the socket are thus established, and a moist socket obtained.

Frequently, following enucleation of an eye the whole socket, with its glass prosthesis, is retracted and sunken; therefore, to improve the

motions of the glass eye, as well as to bring out the normal contours, it is necessary to do some postconjunctival grafting. This is accomplished by fat fascia grafts larger than the normal globe, which are implanted behind the conjunctiva or into the ring of the ocular muscles. When the grafts are placed within the center of the ocular musculature, better motion of the glass eye is obtained. The grafts are placed through horizontal incisions at the depth of the socket and should not be permitted to touch the cilia or mucosa, as grafts are easily infected.

When only small pieces of lining mucosa are left, unless they are on the posterior aspect of the lids or can be used for the lining of the eyelid, they should be excised, and a one-piece graft should be used to line the orbital cavity. When there has been a loss of mucosa of the eyelid, particularly of the upper lid, much better functional and cosmetic results are obtained by utilizing mucosa from the existing socket or grafts of full thickness from the skin of the eyelids. Replacement of the lining of the lid by mucosa from the socket is accomplished by appropriate flaps and incisions mobilizing the mucous membrane and suturing it to the denuded under surface of the eyelids, the donor area of the socket being grafted with an epithelial inlay. When there is a lack of mucosa from the socket, the orbital surface of the upper lid is lined with a Tripier bipedicled flap rotated from the facial side of the lid to its orbital surface (case 4). Either this flap or one designed from the facial surface of the lower eyelid can be used to line the orbital surface of the under lid. The pedicles of these skin flaps are incised within from ten to fourteen days and returned to their bases. If the orbital surfaces of the lids are not covered with mucosa or dermosubcutaneous flaps, several objectional features will often be noted in the reconstructed socket. The tarsal plate of the upper lid will buckle, becoming concave; the cilia will be concentrated in the center of the lid, and entropion or ectropion will result. Such a condition is due to contraction of scar tissue, either contraction of the primary cicatrix or the usual contraction of the base of the Ollier-Thiersch grafts. The mucosa or dermosubcutaneous skin graft reduces this contraction to a minimum by supplying with the grafts subcutaneous tissue for the lining of the lids, where it is most essential. The dermosubcutaneous graft to the lids and the Ollier-Thiersch graft to the remainder of the socket can be implanted at the same time and will materially improve the final function and appearance of the reconstructed socket. In all sockets requiring reconstruction when there has been a loss of the lining of the eyelid, particularly of the upper lid, a very thin dermosubcutaneous flap should be used. This material must be obtained from the areas indicated in the drawings, and when it is not, an Ollier-Thiersch graft for replacement of the lining of the lid and socket will have to be employed.

UNILATERAL CENTRAL AND ANNULAR SCOTOMA PRODUCED BY CALLUS FROM FRACTURE EXTENDING INTO OPTIC CANAL

REPORT OF TWO CASES

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AND
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In the past year an unusual ophthalmologic syndrome has been observed in two cases following a fracture along the base of the skull, although in both cases the fracture, which involved the optic canal, was not revealed by the roentgenogram. Ophthalmologic examination disclosed a normal condition in both cases during the patients' stay in the hospital, but within two months following the accident a change in visual acuity was noted in each case. On examination, central vision of the affected eye was found to be decreased, and the perimetric fields revealed an absolute central scotoma with a large, annular scotoma surrounding it. Explanation of the late occurrence of the ocular phenomena was difficult until roentgenograms of the optic foramen disclosed narrowing on the affected side.

Fracture of the optic canal with narrowing of the optic foramen, such as was revealed by the roentgenograms, has been noted also by White,[1] Van der Hoeve,[2] O. and H., Barkan [3] and others. Changes in the visual field which have been reported usually have indicated some sector defect or central scotomas. We have been unable to find any mention of associated unilateral central scotoma and annular scotoma such as were found in the following two cases.

From the Section on Ophthalmology (Dr. Lillie) and the Section on Neurologic Surgery (Dr. Adson), the Mayo Clinic.

Read before the Section on Ophthalmology at the Eighty-Fifth Annual Session of the American Medical Association, Cleveland, June 14, 1934.

1. White, L. E.: An Anatomic and X-Ray Study of the Optic Canal in Cases of Optic Nerve Involvement, Ann. Otol., Rhin. & Laryng. **33**:121 (March) 1924.

2. Van der Hoeve, J.: Roentgenography of the Optic Foramen in Tumors and Diseases of the Optic Nerve, Am. J. Ophth. **8**:101 (Feb.) 1925.

3. Barkan, Otto, and Barkan, Hans: Fracture of the Optic Canal, Am. J. Ophth. **11**:767 (Oct.) 1928.

REPORT OF CASES

CASE 1.—A man, aged 23, was injured on July 11, 1932, while playing baseball. He was struck on the right side of his forehead with a baseball bat. The skin was lacerated, and there was considerable bleeding. He entered the hospital for emergency treatment, and a roentgenogram of the head revealed a fracture through the frontal bone, just above the right orbit, which apparently extended into the frontal sinus. Fracture along the base of the skull was not observed.

Ophthalmologic examination at this time revealed ecchymosis of both right eyelids and a large, subconjunctival hemorrhage of the right eye. The right pupil was larger than the left, and the reflexes for both light and accommodation in the right eye were diminished. Those of the left eye were normal. Ophthalmoscopic examination gave negative results. The visual fields were normal. A diagnosis of partial right internal ophthalmoplegia was made, and near vision was improved to normal with addition of a +2 sphere. Neurologic examination gave negative results except for the ophthalmoplegia just mentioned.

At operation, the neurosurgeon found a definite fracture of the right supra-orbital ridge, with slight displacement. There was marked fragmentation of bone, and spicules had been driven into the frontal sinus. The patient was dismissed within a week with no apparent residual effects.

He returned to the clinic on September 1, because of progressive loss of vision in the right eye which he had noticed for one month. Ophthalmologic examination at this time revealed vision of the right eye to be 6/60, and of the left eye, 6/6. The right pupil was larger than the left, and the reflexes of the right eye were diminished for both light and accommodation; the reflexes of the left eye were normal. Ophthalmoscopic examination revealed definite pallor of the right disk with the suggestion of a slight loss of substance. The perimetric fields revealed definite central and annular scotoma in the right eye with the form field normal (fig. 1). In the left eye the field was normal throughout. Roentgenograms taken at this time revealed the old fracture of the right frontal bone with involvement of the right frontal sinus and superior wall of the orbit. The right optic foramen was definitely narrowed, whereas that on the left was within normal limits.

The patient was seen again on October 18, when the ophthalmologic findings were the same. At this time it was suggested that operation, enlarging the optic foramen, might bring about visual improvement. The patient refused to have this performed.

It is interesting that the ophthalmologic syndrome did not develop for at least from one month to six weeks following the injury. This apparently was the interval necessary for the formation of the callus which resulted in the narrowing of the optic canal later shown by the roentgenogram.

CASE 2.—A woman, aged 29, was injured on Jan. 15, 1933, when the automobile in which she was riding was struck by a locomotive. She was unconscious five hours. Roentgenograms of the head gave negative results, except for evidence of calcification of the pineal gland. A roentgenogram of the pelvis revealed fracture of the ischium and pubis. Ophthalmologic examination revealed ecchymosis of both left eyelids with tenderness over the upper temporal margin of the orbit. The right pupil was larger than the left. The reflexes and the fundi were normal, although there was slight excess glial substance on the margin of the disk of each eye. The perimetric fields were normal, and the patient had no visual complaints.

A roentgenogram of the pelvis made on February 28 revealed a fracture through the superior ramus, and a comminuted fracture of the inferior ramus, of the pubis. Roentgenograms of the knee, cervical spine, thorax, sinuses, right shoulder and clavicle gave negative results. Following recovery from the pelvic injury, the patient was dismissed from the hospital.

The patient returned to the clinic on June 20, complaining of progressive loss of vision of the left eye during the previous two months. Ophthalmologic examination at this time revealed vision of the right eye to be 6/7, and that of the left eye, 6/20. The pupils were equal, and the reactions to light and in accommodation

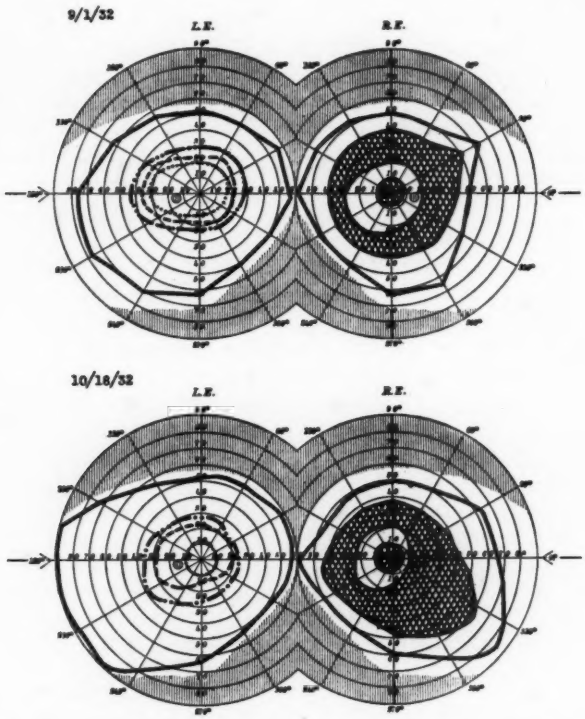

Fig. 1.—Central and annular scotoma in the right optic field due to compression of the optic nerve by a callus, which followed a fracture of the sphenoid bone; the fracture extended into the optic canal.

were normal. Ophthalmoscopic examination gave negative results. The perimetric fields of the right eye were normal, but in the left eye there was absolute central scotoma with a large annular scotoma (fig. 2). Roentgenograms made on June 24 gave evidence of abnormality of the contour of the left optic canal, resulting in a narrowing of the canal (fig. 3 *A*). The roentgenogram of the wall of the right optic canal was normal (fig. 3 *B*).

Neurologic examination gave negative results, except for persistent anesthesia over the frontal area. An operation for decompression of the left optic canal was performed by one of us (A. W. A.) on July 10.

An osteoplastic flap over the left frontal area was employed to expose the left half of the anterior fossa. The dura was elevated, and the left frontal lobe also was elevated until the lesser wing of the sphenoid, the optic nerve and the optic

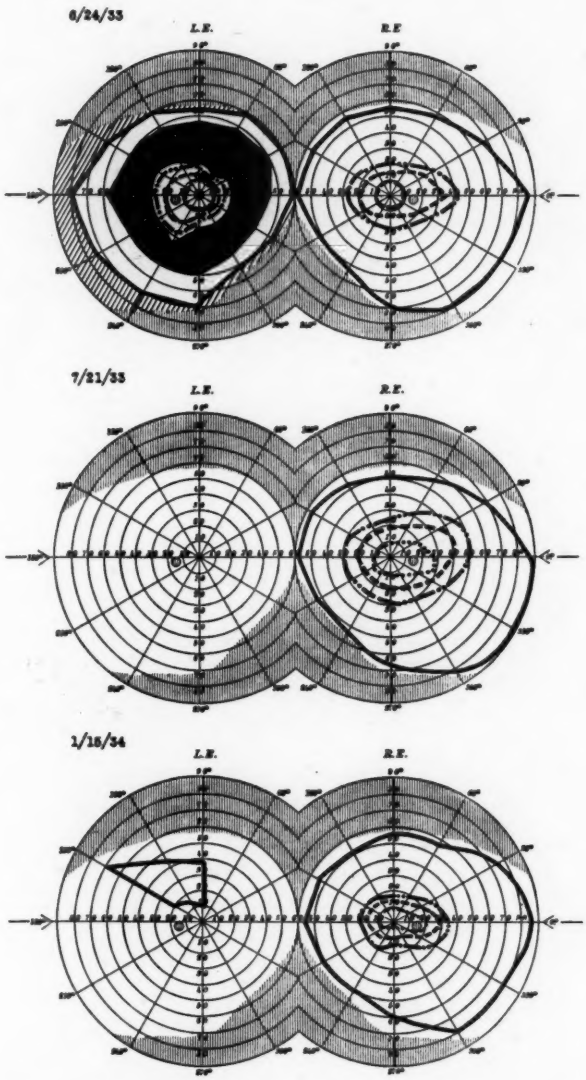

Fig. 2.—Central and annular scotoma in the left optic field due to compression of the optic nerve by a callus which followed a fracture of the sphenoid bone; the fracture extended into the optic canal.

groove of the sphenoid were exposed. The orbit was trephined, and an oblong portion of bone was cut for decompression in the direction of the optic nerve. This portion of bone was about 1 cm. in width. As the anterior clinoid process was approached, two spicules of bone came away, one of which measured 15 by 5 mm.

and the other 7 by 3 mm. Apparently the two loose spicules of bone, including the anterior clinoid process, were part of the previous fracture. It was apparent that the fracture extended into the optic foramen on the lateral inferior surface,

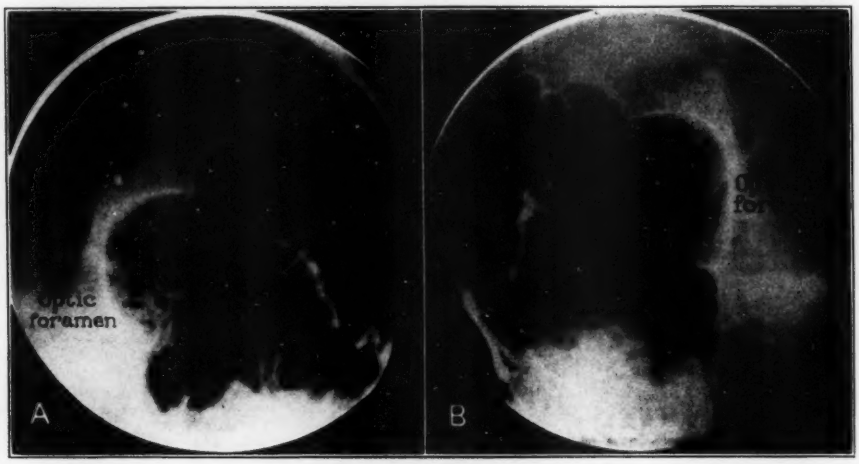

Fig. 3.—*A*, narrowed left optic foramen due to the growth of a callus into the canal as illustrated by a roentgenogram taken on June 24, 1933. *B*, normal right optic foramen as illustrated by a roentgenogram taken on June 30, 1933.

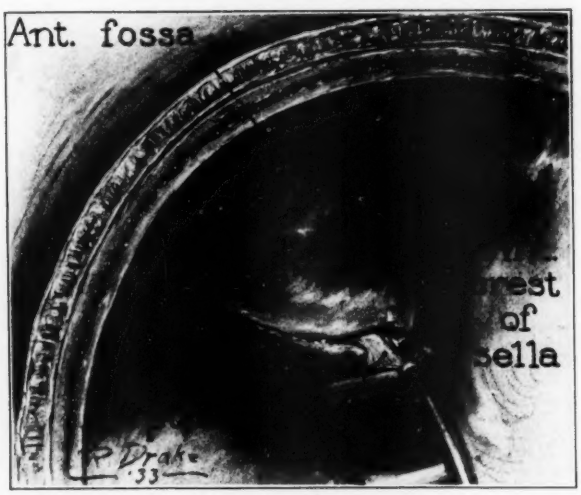

Fig. 4.—Compression of the left optic nerve by an outgrowth of callus from a fracture of the lesser wing of the sphenoid.

and that this fracture developed a callus which had compressed the optic nerve to about two thirds its normal size (fig. 4). The optic nerve was decompressed thoroughly (fig. 5) and without any difficulty. Special care was taken to remove the callus and bony fragments (fig. 6) to the left and from the inferior side of

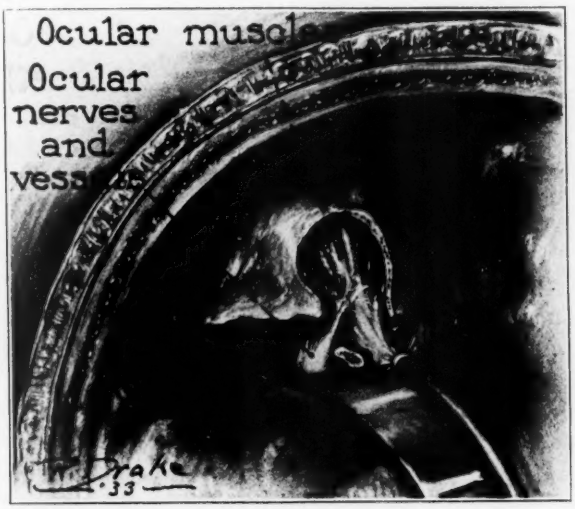

Fig. 5.—Decompression of the left optic nerve from the orbit to the middle fossa, exposing the compression notch of the optic nerve as well as the structures that pass through the sphenoidal fissure.

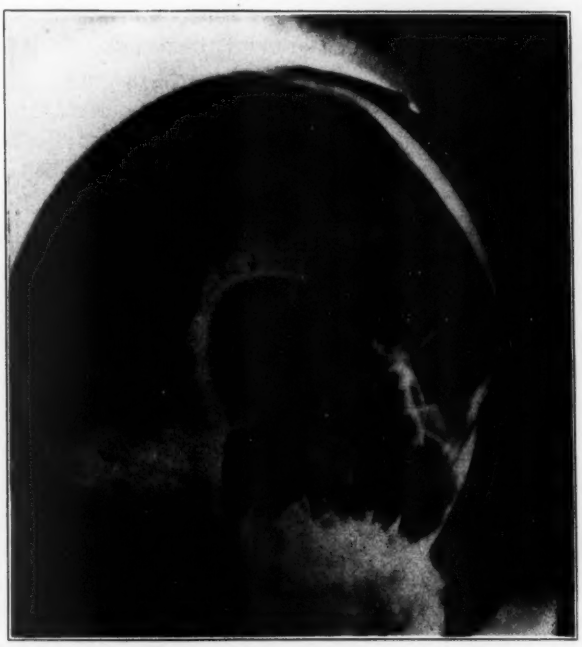

Fig. 6.—Roentgenogram made on April 3, 1934, illustrating the extent of the decompression in the left orbit and optic canal.

the optic nerve. There were no hematomas in the orbit or in the sheath of the optic nerve. The dura could readily be seen to extend its envelop about the optic nerve to the ocular muscles; the dural sheath over the structures that passed through the anterior lacerated space could also be seen. There was no apparent arterial congestion or venous engorgement. The dural sheath about the optic nerve was not opened, as the decompression had liberated the nerve. From a surgical point of view, we expected considerable recovery from the visual defects, which to date has not taken place. Extreme care was taken not to injure the optic nerve during operation; hence, we were led to believe the lesion had progressed too far before decompression of the optic nerve was performed. Convalescence was uneventful, and the patient was dismissed from the hospital on the seventh day.

The course of events in cases 1 and 2 was similar, and the perimetric field defects were the same in both. It is interesting to note that visual changes were not noticeable until a month or two following the accidents. The roentgenogram of the head at the time of the accident in each case did not reveal any fracture involving the optic canal. The roentgenologic defect was found only after an interval of time in which a callus had formed and the true nature of the pathologic change was ascertained.

SUMMARY

These two cases reveal an ophthalmologic syndrome so similar that it might be classed as almost pathognomonic. At the time of injury both patients had ecchymosis of the eyelids, and the pupils were unequal. There was no visual complaint at the time of injury except in case 1, and this was due to partial internal ophthalmoplegia. Both patients were dismissed from the hospital as well, and it was not until from six weeks to two months later that the progressive loss of vision was sufficient to impress each of them that an examination was necessary. At the time of the second ophthalmologic examination in each case, identical changes in the perimetric fields were found, and the pathologic changes as revealed by the roentgenograms of the optic foramen were similar. Localized roentgenograms of the optic foramen might be of value at the time of injury, and repeated at intervals if necessary. This technic has been simplified by Camp and Gianturco.[4] Although this syndrome apparently is rare following fracture along the base of the skull, its occurrence is sufficient to guard the prognosis following any injury of the skull. We also believe that decompression of the optic nerve is indicated, but that it should be employed early in the progress of the lesion before permanent injury has been done.

ABSTRACT OF DISCUSSION

DR. WEBB W. WEEKS, New York: From my experience and from that of many ophthalmologists with whom this subject was discussed, as well as from the

4. Camp, J. D., and Gianturco, Cesare: A Simplified Technique for Roentgenographic Examination of the Optic Canals, Am. J. Roentgenol. **29**:547 (April) 1933.

reports of cases recorded in the literature, these two cases represent a type that is too infrequently recognized, and then only when it is too late to do anything to relieve the condition causing the loss of vision.

The optic canal may be involved in any fracture of the skull, but it is most commonly involved when there is violence in the neighborhood of the external angular process of the frontal bone. This results in partial or total primary atrophy of the optic nerve, nearly always unilateral, with an almost identical clinical history and finding: a blow on the head, usually near the orbit, not severe enough to cause unconsciousness; blindness on the same side, with the pupil dilated and inactive; no perception of light, and negative ophthalmoscopic findings. After six weeks there developes primary atrophy of the optic nerve with normal retinal blood vessels and a negative roentgen picture.

A direct tear of the optic nerve is more likely to occur, as fractures of the base of the skull are fissured, with, as a rule, little displacement of the bony parts.

Those who have examined fractures through the optic canal have found no hemmorrhage in the intravaginal space except where an extensive fracture of the base has occurred with a more or less widespread subdural hemorrhage.

A comminuted fracture of the roof of the sphenoid sinus might cause the formation of a callus sufficient to produce complete atrophy of the nerve. The condition which has taken place in these two cases is most likely due to pressure from a callus affecting the centrally placed papillomacular bundle (one third of the fibers in the optic nerve are from the macular area, although it is only one twentieth of the whole retina in size), with a central scotoma followed by sector-like scotomas due to unequal impairment of the blood supply to the area of nerve involved. Early operative intervention by the transcranial route is clearly indicated.

A case with a central scotoma and perhaps other defects of the visual field, paracentral or even sector-like scotomas, in which trauma, direct or indirect, is ruled out, brings one to the consideration of a variety of conditions, such as tumors of the frontal lobe, posterior ethmoid or sphenoid sinusitis, chronic poisoning due to tobacco or wood alcohol, diabetes or even disseminated sclerosis.

The fractures have been properly oriented by the excellent lantern slides shown by Dr. Keyes and Dr. Adson. A few lantern slides from Dr. Vance's report on 512 necropsies showing fractures through the base are interesting. He classifies them as follows: posterior location from violence, 35 per cent; lateral location, 45 per cent, and anterior location, only 12.5 per cent, 10 per cent of which showed fissured fractures involving the optic foramen.

I should like to ask Dr. Lillie if in his experience and from his findings the anterior clinoid process, as has been mentioned in reports, is the cause of compression, and how he explains the paracentral scotoma.

Dr. Walter I. Lillie, Philadelphia: Dr. Weeks has asked a question that I am unable to answer. I should like to know the reason myself. I thought that perhaps I would get an explanation as to the presence of the annular scotomas. Fractures along the base of the skull are common, and Barkan recently showed numerous types of central and sector defects in the visual fields, but none with the associated annular scotoma. The central scotoma is common, and must be due to fracture of the canal with resulting callus formation. It must be a pressure syndrome, as it is slowly progressive and simulates that which is produced by a basal lesion of the frontal lobe, although I never have seen an annular scotoma associated with a basal tumor of the frontal lobe.

From the ophthalmologic standpoint, this is a retrobulbar neuritis syndrome, appearing from six to eight weeks after the trauma. A roentgenogram of the optic

canal gave evidence of the true pathologic process. These two cases are very similar and are the only ones we have ever seen of fractures involving the optic foramen that have produced this type of a defect of the visual field.

Dr. Adson will take up the question of the fracture of the anterior clinoid process.

Dr. Alfred W. Adson, Rochester, Minn.: In reply to Dr. Weeks' discussion on fractures in the middle fossa, the fragment in our case had been cracked loose and consisted of a portion of the anterior clinoid process and part of the greater wing of the sphenoid. The crack extended from the anterior clinoid process into the optic canal, but apparently no pressure developed until the callus began to form and fill in the optic canal. We have all seen patients who have had fractures in the middle fossa which have extended into the optic canal, with lacerations of the optic nerve and resulting blindness. I had never explored one before, and it was only at Dr. Lillie's suggestion that I did so in this case.

I am sure that the case reported is rare and that the surgical procedure will not be employed often. Since all of us are trying to advance the science of medicine, we thought it worth while to report it. If I were to operate in a similar case, I should do so much earlier than I did in our case.

ALTERATIONS OF RETINA IN EXPERIMENTAL TOXIC NEPHROSIS

V. LA ROCCA, M.D.
NEW YORK

The purpose of this study is to investigate the relation of renal lesions to the retinal alterations which appear during the course of chronic nephritis. While the clinical and pathologic observations on the subject and the hypotheses explaining the phenomena are numerous, the experimental investigations which may help to interpret the clinical and pathologic findings are scanty.

Bright, about one century ago, expressed the opinion that the retinal alterations depend on the renal insufficiency, and since albuminuria is one of the chief symptoms of nephritis, he ascribed the retinal lesions to the presence of albumin. Graefe [1] later said that this form of retinitis is due to a general disease of the arterial system, or to a cause which attacks the renal vessels as well as the retinal vessels. According to him, there is a primary degeneration (arteriophlebosclerosis) of the retinal vessels which brings about all the retinal lesions.

The theories on the subject were afterward modified by the discoveries in the field of blood chemistry, and many authors, for instance, Widal,[2] Achard,[3] Poulard,[4] Richter [5] and Rochon-Duvigneaud,[6] have contended that the retinitis develops from the azotemia. Others have expressed the belief that it comes from circulatory disturbances, with increased blood pressure and contraction of the small arteries of the body, and that the azotemia produces an exudation of fibrin into the tissue of the retina (Leber [7]). Others have claimed that the retinitis arises from hypercholesteremia (Chauffard; [8] Lauber; Adamuk; Fahr;

From the research department of the Brooklyn Eye and Ear Hospital.

1. von Graefe and Schweigger: Recherches clinique, Ann. d'ocul. **49-50**:136, 1863.

2. Widal, F.; Morax, V., and Weill, A.: Albuminuric Retinitis and Azotemia, Bull. et mém. Soc. méd. d. hôp. de Paris **29**:429 (April 22) 1910.

3. Achard, C.: Le système lacunaire, Paris, Masson & Cie, 1924.

4. Poulard, A.: Traité d'ophtalmologie, Paris, Masson & Cie, 1923.

5. Richter, F., in Kraus, F., and Brugsch, T.: Spezielle Pathologie und Therapie innerer Krankheiten, Berlin, Urban & Schwarzenberg, 1925, vol. 7, p. 513.

6. Rochon-Duvigneaud: Vessel Lesions in Albuminuric Retinitis, Ann. d'ocul. **131**:485, 1904.

7. Leber: Ueber die Entstehungsweise der nephritischen Netzhauterkrankung, Arch. f. Ophth. **70**:200, 1908.

8. Chauffard, A.: Local Deposits of Cholesterol and Their Relations with Cholesteremia, Rev. de méd., Paris **31**:176, 1911.

Chabanier, Lobo-Onell and Besnard [9]); from extrarenal causes, such as cardiovascular disturbances (Achard [3]); from hypertension due to an endocrinosympathetic disturbance (Kilu; Lianet; Hagenau); from ischemia and anoxemia (Volhard); from arteriosclerosis (Charles de Bartière; von Michel); from simple inflammation (Hansen; Knak); from inflammation associated with toxic renal substances (lo Cascio), and from extrarenal causes (Puscariu and Nitzulescu [10]). The last mentioned authors admitted, however, that the renal causes may act as preparatory causes.

None of the investigators has succeeded in obtaining in an experimental way the classic picture of the retinitis which one is accustomed to see clinically. Ousemblo,[11] in 1892, first tried to provoke experimental alterations in the retinas of dogs and rats by phosphorus poisoning. He obtained edema and fatty and colloidal degeneration of the cells, sclerosis and atrophy of the fibers and thickening and fatty and hyaline degeneration of the epithelium of the vessels, but no inflammatory reaction. Orlandini,[12] in 1902, injected diphtheria toxins into rats. He obtained abundant albuminuria, hemorrhage and necrosis of the renal epithelium and after some time hemorrhages in the retinas. In 1924 the same investigator cauterized with silver nitrate the kidneys of a number of rabbits, but in the short survival of the animals there were slight alterations in the retinas. Shiba,[13] in 1908, injected a diluted solution of tincture of iodine into the renal parenchyma of rabbits and obtained slight edema of the retinas.

Zur Nedden,[14] in 1909, by removing both kidneys of rabbits did not produce any retinal change; later by inoculating other rabbits with nephrotoxins (which he had obtained by a special method) he produced some alterations in the inner layers of the retinas which he thought were albumins identical to those in the kidneys. Fusita,[15] in 1912, repeated the Zur Nedden experiment but did not find any change in the retinas.

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9. Chabanier, H.; Lobo-Onell, C., and Besnard, C.: Rétinite albuminurique l'insuffisance sécrétoire des reins, Presse méd. **32**:113, 1924.

10. Puscariu, Elena, and Nitzulescu, J.: Pathologic Remarks on Albuminuric Retinitis, Jassy, 1927.

11. Ousemblo, A.: Pathologic Changes of the Retina in Phosphorus Poisoning, Thesis, St. Petersburg, 1892.

12. Orlandini: Diseases of the Optic Nerve and Retina, Ann. di ottal. **33**:56, 1904.

13. Shiba: Recherches sur la rétinite albuminurique, Klin. Monatsbl. f. Augenh., 1919, p. 387.

14. Zur Nedden, N.: Ueber spezifische Beziehungen zwischen Netzhaut und Nieren nebst Bemerkungen über die Genese der Retinitis albuminuria, Arch. f. Augenh. **63**:217, 1909.

15. Fusita: Nippon Gankwa Gakukwai Zasshi, Dec., 1912.

My experiments [16] were done with white rabbits and were divided into three series. In one I provoked only subacute nephrosis by subcutaneous injections of uranium acetate; in the other two series I associated with the renal lesions some vascular lesions by injections of specific vascular poisons, (*a*) glyceryltrinitrate and trinitrin, (*b*) epinephrine. As in each series of experiments the course of the disease, the anatomic lesions in the internal organs and in the retina were substantially the same, in order to save space it will suffice to describe only one experiment.

SERIES 1: INJECTIONS OF URANIUM ACETATE

Eight white rabbits were inoculated with a solution of uranium acetate. Three of them died from two to five days after the first injection with such slight signs of renal insufficiency that autopsy was judged superfluous. The other five lived from fourteen to eighteen days. Each rabbit received the same treatment and the same diet.

RABBIT 1.—*Experimental Course.*—The weight at the beginning of the experiment was 1,150 Gm.; after eighteen days, 730 Gm. (difference, 420 Gm.).

A subcutaneous injection of 0.25 mg. of uranium acetate was given daily for five days. No albumin was found in the urine; the microscopic examination of the sediment showed crystals of ammoniomagnesium phosphate, crystals of uric acid and leukocytes. Ophthalmoscopic examination gave negative results.

A subcutaneous injection of 0.5 mg. of uranium acetate was given daily for four days. In the urine were found a few hyaline and granular casts and a slight trace of albumin. Ophthalmoscopic examination still gave negative results.

A subcutaneous injection of 1 mg. of uranium acetate was again given every day for nine days. The amount of albumin in the urine was considerable, and the number of casts steadily increased, reaching the maximum in the last three days of life. A few red blood cells were present. The specific gravity was 1.020. Examination of a catheterized specimen of urine gave the same results.

The rabbit died on the eighteenth day from the first injection. The total amount of uranium acetate injected was 12 mg.

Autopsy.—There was a moderate amount of liquid in all the serous cavities. The kidneys, the retroperitoneal tissues and the mediastinum were edematous. The capsule of the kidneys was easily detachable, and the surface was smooth. The cut surface was edematous; macroscopically no hemorrhages were seen.

The liver was congested; on the cut surface were seen some round yellowish spots as large as a grain of millet, due probably to a coccidial infestation.

The spleen looked normal. The lungs were slightly edematous. The heart was normal. The brain was slightly edematous.

Histologic Examination.—Kidneys: In the sections stained with hematoxylin and eosin one was struck by the enormous number of casts evenly stained with eosin that nearly filled the collecting tubules of the substantia medullaris. In the cortex there were remarkable alterations of the convolute tubules. The cells were swollen and the lumens were often obliterated. In the sections fixed in Flemming's solution the fatty degeneration of the elements of the convolute tubules was clearly shown by the characteristic presence of many droplets, stained black by the osmic

16. These experiments were begun in Italy in the Pathologic Institute of the Royal University of Palermo under the supervision of the late Prof. U. Soli and continued later in the research department of the Brooklyn Eye and Ear Hospital.

acid. The glomerules showed slight alterations. Occasionally red blood cells were seen in the Bowman spaces. Some tufts were adherent to Bowman's capsule.

Liver: The epithelium of the bile canals was thickened and infiltrated with small leukocytes, polymorphonuclears and eosinophils. This lesion was to be attributed to the coccidiosis. Moreover, there were other lesions that depended on the toxicosis by uranium, i. e., small cavities in the central part of the acini due to fatty degeneration. The fats were evidently dissolved during the preparation.

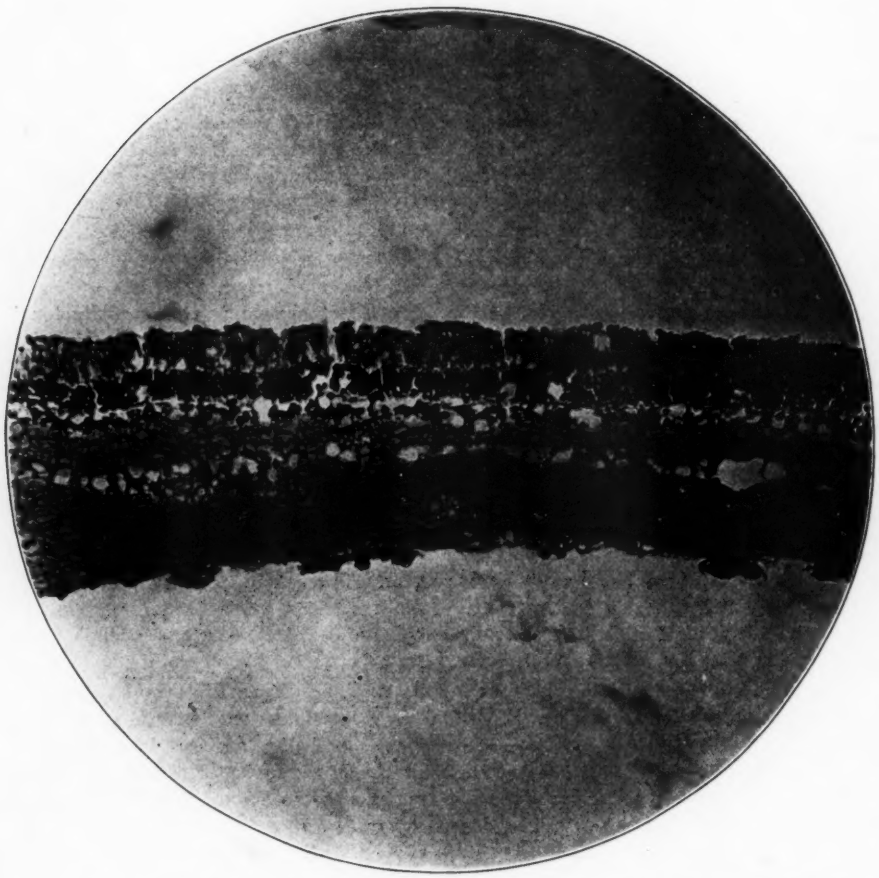

Fig. 1.—Histologic appearance of the retina of a white rabbit with subacute nephrosis induced by uranium acetate. The section shows vacuoles, mainly in the nerve fiber, ganglion cell and nuclear layers. The rods and cones are less injured, and some cavities found there are artefacts.

Retina: Some sections were fixed in Müller's fluid and a dilute solution of formaldehyde and stained only with hematoxylin. Others were fixed in Flemming's solution and stained with safranine. In spite of carefulness during the preparation, the retina was almost completely detached from the choroid. The retina appeared to be edematous, and small vacuoles were found in the nerve fiber layer, ganglion cell layer and nuclear layer. The number and distribution of the vacuoles differed

in various sections and in different parts of each section. The layer of rods and cones was generally less injured. The optic nerve head appeared essentially normal; in some sections it was slightly edematous. The Müller fibers were slightly swollen. No hemorrhage or exudation was found. In all sections the retina was detached by artefaction. Sections stained by osmic acid did not show any fatty degeneration. A few small black points that appeared in the layer of the rods and cones were probably due to the physiologic content of lipoids in the retina.

Fig. 2.—Histologic appearance of the optic nerve head in the rabbit a section of whose retina is shown in figure 1. Small cavities may be seen in the fibers. The retinal detachment is probably an artefact, as no sign of exudation can be seen between the retina and the choroid.

SERIES 2: INJECTIONS OF GLYCERYL TRINITRATE AND URANIUM ACETATE

Five rabbits were inoculated. The average time of death was the twenty-fifth day. The glyceryl trinitrate was injected into the marginal vein of the ear. The official alcoholic solution of glyceryl trinitrate 1 per cent was diluted one

hundred times in physiologic solution of sodium chloride and made fresh every day before it was employed so that the solution in water would not lose its hypotensive power.

RABBIT 1.—*Experimental Course.*—For seven days the animal received one intravenous injection every day of 3 cc. of glyceryl trinitrate; for two days, two injections every day of the same solution, and for two days, one injection. For four days it received one injection every day of 2 cc. of glyceryl trinitrate and one subcutaneous injection of 2 cc. of uranium acetate in a dilution of 50 per cent. The examination of the urine showed fairly abundant albumin and no casts.

For three days the injections of glyceryl trinitrate were repeated in the usual manner. Anuria was first noticed at this time. Later the urine was scanty and contained many casts and abundant albumin. For the next four days the animal received one injection every day of 2 cc. of glyceryl trinitrate and 2 cc. of uranium acetate. The examination of the urine showed casts and albumin, and the specific gravity fell to 1.010.

The rabbit died on the twenty-third day. The urine taken directly from the bladder had the same characteristics. The total amount of glyceryl trinitrate injected was 61 cc. of the solution in water in a concentration of 1 per cent. The amount of uranium acetate injected was 8 mg.

Autopsy.—A small amount of liquid was found in all the serous cavities; the subcutaneous tissue was edematous. The kidneys were large, of normal consistency and congested. The cut surface showed some edema but no hemorrhages. The liver and spleen were normal. The lungs and brain were slightly edematous.

Histologic Examination.—Kidneys: Both in the slides fixed with Müller's fluid and formaldehyde and stained with hematoxylin and eosin and in those fixed with Flemming's solution, the lesions were those of severe acute nephrosis, i. e., dilatation of the collecting tubules and of the Henle loops. The lumens of the tubules were filled by hyaline casts; in some of the casts a few morphologic elements were seen, polymorphonuclear leukocytes and epithelial cells. The epithelium of the convolute tubules was altered; the nuclei were scarcely stained, and the protoplasm was degenerated. In the slides fixed with Flemming's solution, the fatty degeneration of the tubules was very clear by the presence of fine black droplets in the protoplasm of the cells. The glomerules showed little change except the presence of a few red blood cells in the Bowman spaces.

Liver: The blood cells were engorged. Around the vessels and the bile ducts there were a moderate infiltration of lymphocytes and a slight increase of the connective tissue. The vacuolar and fatty degeneration of the hepatic cells was generally more pronounced than in the rabbit of the first series.

Renal Artery: No lesions were seen.

Aorta: In some tracts in the media the muscular fibers were separated from the elastic fibers, so that small spaces were formed. These were mostly oblong, following the direction of the fibers, or irregularly oval. These spaces were the expression of an edematous condition of the wall of the artery. No special alteration was seen in the intima.

Retina: A few alterations were seen in some of the slides, consisting in small vacuoles in the nuclear layer. The retina was not seen to be detached except in a few slides, showing that the integrity of the tissue was better preserved than in the animals of the first series.

SERIES 3: INJECTION OF EPINEPHRINE AND URANIUM ACETATE

Fifteen rabbits were used. Only in two, surviving, respectively, twelve and seven days, was it possible to associate the injections of uranium acetate with those of epinephrine. The others died, some immediately following the first injection of epinephrine and some a few hours or days later, but always before I tried to associate the uranium acetate. Death was preceded by a characteristic shock: tremors, paralysis first of the hindlegs and then of the forelegs, marked opisthotonos and mydriasis.

RABBIT 1.—*Experimental Course.*—For five days the animal received one intravenous injection every day of 0.5 cc. of epinephrine chloride 1:1,000, and for the following seven days, one injection every day of 1 cc. From the eighth to the twelfth day it received one subcutaneous injection daily of 2 cc. of uranium acetate in a 50 per cent dilution. On the twelfth day, following the injection of epinephrine there were paralysis of the hindlegs and tremors and then paralysis of the forelegs. The animal died in opisthotonos and marked mydriasis. The total amount of epinephrine chloride injected was 9.5 cc. The amount of uranium acetate was 0.5 mg.

Examination of the urine showed no albumin or casts. Ophthalmoscopic examination throughout the course gave negative results.

Autopsy.—No liquid was found in the serous cavities. In the aorta were seen round areas the size of a millet seed or smaller; some were disseminated, but many had coalesced and formed larger patches with scalloped edges. These lesions were more evident on the arc of the aorta. Palpation showed a clear, calcareous consistency.

Histologic Examination.—The slides of the kidneys and liver did not show any alteration worthy of mention.

Blood Vessels: Lesions were clear in the slides of the renal artery and of the aorta. The renal artery in all its length showed characteristic areas of advanced calcification. These areas were very clear in the media, especially in the inner part near the intima, so that the latter in some portions was raised. The intima itself did not show any special alteration except that in a few spots it was slightly thickened. The areas of calcification had a remarkable extension but usually were limited to a portion of the vessel only. The slides stained with hematoxylin and eosin showed that the areas were formed by crystalline, colorless masses and by granular matter strongly stained with hematoxylin.

The lesions in the aorta were less severe than those in the renal artery; in some parts the normal structure was preserved. It was possible to see the various steps leading to sclerosis of the vessel. The process started with a deposit of calcium salts in the spaces between the elastic fibrils of the media, destroying first only the muscular cells usually existing in these spaces. In other parts, where sclerosis was more advanced, the elastic fibrils too were destroyed by the calcium deposit. The intima looked unmodified throughout the length of the artery.

Retina: In all the slides the retina looked normal. There were none of the vacuoles noticed in the retinas of the rabbits in which the nephrosis was more severe and the amount of uranium acetate injected was greater.

RÉSUMÉ OF EXPERIMENTAL WORK

In the first series, by injecting subcutaneously only uranium acetate I obtained in white rabbits typical subacute nephrosis and fatty degeneration of the liver. The retinal lesions, which were more severe in the rabbits that survived for a longer time, consisted in small vacuoles in

the nerve fiber layer, ganglion cell layer and nuclear layer with a few in the optic disk. The detachment of the retina noticed probably was an artefact.

In the second series, by associating glyceryl trinitrate intravenously with uranium acetate subcutaneously, the retinal alterations were similar to those of the first series but less pronounced, as the amount of uranium acetate was diminished and the renal alterations were less severe. There was slight edema of the wall of the arteries, as was

Fig. 3.—Histologic appearance of the aorta in the rabbit into which epinephrine was injected. The section shows the calcification of the media. The intima is preserved. Notice the various steps leading to the sclerosis of the vessel.

pointed out by the enlargement of the spaces between the elastic fibers of the media.

In the third series, in which the amount of uranium acetate injected was still less than in the former two and there was no alteration of the kidneys, the retina was normal. Very remarkable was the sclerosis of the large and middle-sized arteries.

CONCLUSIONS

In the renal toxicosis produced by uranium acetate in white rabbits, I noticed edema of the inner layers of the retina and of the fibers of the

optic disk. In some parts the separation of the elements of the retina resulted in the formation of cystlike spaces. The edema was more pronounced in the animals in which the renal lesion was more severe and the toxicosis lasted longer. These changes in the retina and optic nerve may be interpreted as an initial or mild nephritic retinitis, as I failed to obtain the typical picture with hemorrhages, cotton-wool patches and star figures even in those cases in which the renal manifestations were characteristic (albuminuria, casts, degeneration of the renal tubuli).

The association of a vascular poison, glyceryl trinitrate, did not modify the retinal alterations, as the edema in these cases was less remarkable. There were alterations in the aorta, which may be considered as slight edema of the vessel wall, namely, enlargement of the spaces between the muscular fibers and the elastic fibers.

The association of epinephrine did not modify the characteristic alterations of the retina produced in the first series. Because of the short period of survival and the small amount of uranium acetate injected, there were no renal or retinal lesions. The only remarkable alterations were in the large and medium-sized arteries and consisted in deposits of calcium salts in the media with destruction of the muscular and elastic fibers.

Regarding the influence of the integrity of the vessel walls and the part that they play in determining the edema of the retina, in my cases the retinal lesions were less pronounced when there was an alteration of the walls of the vessels. Alteration, however, was not seen in the retinal artery or in the other small arteries, but in the large and medium-sized vessels, so that no deduction can be drawn from this fact in favor of or against the part played by the vessels in the production of the edema of the retina. This in some way confirms what Leber [7] said, that the histologic changes in the vessels, though frequent, do not constitute a condition sine qua non. In my series of experiments there were no star figures around the macula or white spots in the retina, indicating lipoid deposits, and the few black points in the layer of rods and cones observed in the sections stained by osmic acid must have been due to the physiologic content of lipoid in the retina.

The only fact that stands out positively from my experiments is that the severity of the renal lesions and the severity of the retinal edema were equal, and that both were more pronounced in the rabbits into which it was possible to inject more uranium acetate and which survived for a longer time.

It is my opinion that nephritic retinitis is caused by different factors combined, the renal insufficiency playing the greatest part.

THE CONJUNCTIVOGLANDULAR SYNDROME OF PARINAUD

REPORT OF A CASE SHOWING A THREAD MOLD IN SECTIONS

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AND
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In 1927, one of us [1] reported observing a threadlike organism in two out of three cases presenting the clinical picture of Parinaud's conjunctivitis. The organisms were very delicate and were demonstrable only in thin sections stained by Verhoeff's modification of Gram's method. They resembled the organisms observed by Verhoeff in seventeen of eighteen cases,[2] except that some threads showed apparent branching and in one case a large clump of threads radiating from a central clear area was seen. Dr. Verhoeff examined this material and stated that the organisms were identical with those observed in his cases. Aside from Verhoeff's cases, Keiper, Lemoine and Dunphy reported the presence of similar organisms in material sent to Dr. Verhoeff for staining.

At that time, cultures of a similar organism had been made only by Wherry and Ray from the preauricular gland of a patient, no conjunctival tissue being excised for examination. Their organism was gram-negative, but they considered it identical with that described by Verhoeff. In 1933, Verhoeff and King [3] in three of four typical cases obtained cultures of a similar threadlike organism which produced lesions when injected subconjunctivally into rabbits. The organisms were usually gram-negative, though one strain retained the stain when Verhoeff's method was employed. Primary cultures were obtained only on serum agar and dextrose agar when 10 per cent of air was replaced by carbon dioxide. Sections in all four cases showed organisms similar to those seen in previous cases. In this report the authors stated that the same organisms had been found in sections from 44 of 45 patients examined by Dr. Verhoeff.

Aside from the cases reported by one of us, the organisms described by Verhoeff have, then, been found only in material stained in his labo-

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From the Department of Ophthalmology, Northwestern University Medical School.

1. Gifford, S. R.: Am. J. Ophth. **10**:484, 1927.
2. Verhoeff, F. H.: Arch. Ophth. **42**:345, 1913; Am. J. Ophth. **1**:702, 1918.
3. Verhoeff, F. H., and King, M. J.: Arch. Ophth. **9**:701 (May) 1933.

ratory. This is not so hard to explain as might appear, since the organisms are exceedingly delicate and become invisible if differentiation in chloroform is carried on a second too long. Once they have been stained and identified successfully by an observer, it becomes much easier for him to see them in material subsequently observed. It is necessary that the material include one of the yellow points of necrosis, as organisms are rarely seen outside such areas. Few authors have reported careful attempts to employ Verhoeff's method in examining their material. Tissue should be fixed in Zenker's fluid. With solution of formaldehyde, identification of the threads is more difficult but not impossible.

Since the last report by one of us, material from three cases has been examined. In one case no organisms were observed. In the second no typical threads were seen, and certain bodies which stained gram-positively were not considered as organisms by Dr. Verhoeff, to whom they were submitted. The changes of tissue in this case he considered to be more suggestive of tuberculosis than of Parinaud's conjunctivitis. Cultures in this case by the technic which he and King described were negative.

REPORT OF CASE

A description of the third case, the subject of the present report, follows:

R. H., a boy, aged 11 years, had noticed discomfort in the right eye for four days, with swelling of the eyelids and right side of the face and difficulty in opening the mouth wide. There was a slight discharge, and the eyelids were adherent in the mornings.

The previous history was without significance, except for chronic osteomyelitis of the right os calcis.

Examination showed a moderate generalized swelling of the right upper eyelid, with inflammation of the palpebral conjunctiva. Near the upper part of the fornix conjunctivae were many papillary swellings of the conjunctiva, and near the middle of the fold was a flat mushroom-shaped granulation about 3 mm. in diameter. Ulceration was not present. The globe was normal. The right preauricular and cervical glands were swollen and tender. Examination of the nose, throat and ears gave negative results, and general examination showed only the signs of osteomyelitis of the right os calcis, which was now practically healed.

Examination of the blood showed 75 per cent hemoglobin, 4,400,000 red cells and 8,000 white cells. The differential count showed 72 per cent polymorphonuclears, 20 per cent lymphocytes, 6 per cent large mononuclears and 2 per cent eosinophils.

On the tenth day of the illness blood was obtained, and agglutination with Bacillus tularensis, performed in the Illinois Board of Health Laboratory, gave negative results. Careful questioning of the patient and the parents revealed no contact with rabbits at any time. The boy played occasionally with a neighbor's dog which had "a lump under the jaw."

With no other treatment than the use of a mild antiseptic wash the conjunctiva and glands returned to normal within six weeks.

On the eighth day of the illness the largest granulation was removed for examination. It was impossible to obtain cultures, as the patient could not be brought to the hospital.

The microscopic observations were as follows:

The small piece of tissue was stained by Verhoeff's modified Gram method. Most of the tissue removed was rather densely infiltrated by large and small mononuclear cells. The epithelium was irregular over it, but was not ulcerated in the section examined.

There were a number of small thin-walled new vessels. About half of the infiltrating cells were large mononuclears of epithelioid type. There were a number of small areas containing broken-down nuclear fragments, many of which had been phagocytosed. There was no caseation. In sections not too much

Fig. 1.—Section showing cell containing granules arranged as threads, fragments of threads and dots the size of cocci.

decolorized a number of gram-positive elements of varying size were seen. Some were small granules arranged in chains and connected by delicate lines. Others were the size of bacilli; while still others were larger, measuring up to 15 microns. These threads were very thin and contained larger granules, often at the ends and angles. Some of these threads seemed to show true branching, although this may have been due to two threads crossing in the section (fig. 1). In one section a mass of threads with a definite radial arrangement was seen. This area was from 21 to 25 microns in diameter, and the threads were from 10 to 12 microns long, radiating from the center and resembling a small actinomycotic granule. The outer ends were slightly clubbed (fig. 2). In sections which had been longer decolorized no threads could be seen; and in others only the gram-positive dots without connecting threads were visible. These were often arranged in chains of

from four to six. In one section a large cell was seen, which contained a great number of the organisms. Some of these were seen as threads, others as smaller fragments of threads and dots the size of cocci (fig. 3).[4]

Two other cases showing an almost identical clinical picture were seen by one of us (E. E. D.) during the past year. In each the differential blood count was normal, and the agglutination test for tularemia gave negative results. In one of the patients, a farmer's wife, there was a history of contact with cats having "sore eyes." This is interesting

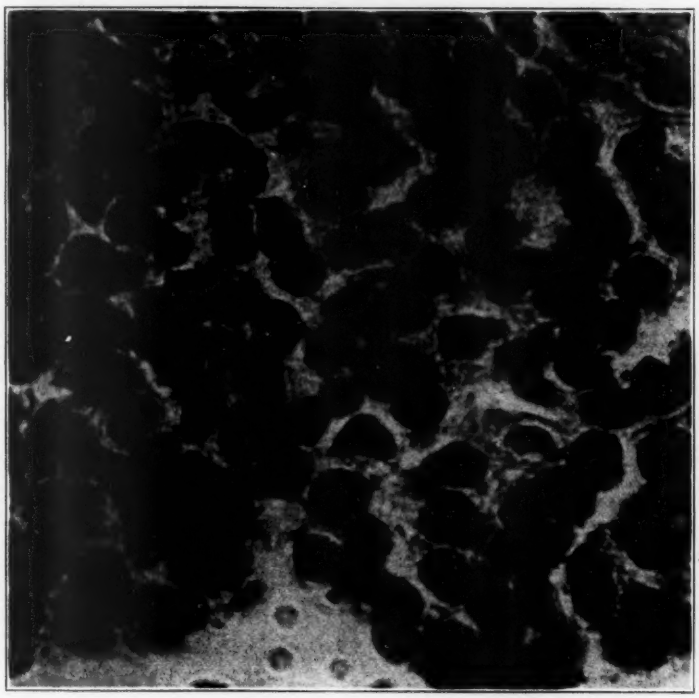

Fig. 2.—Section showing mass of threads with a radial arrangement.

in view of Parinaud's belief in an animal origin of the infection and of the fact that in several other cases contact with a cat was mentioned. The duration of the conjunctival involvement and glandular swelling was approximately five weeks in one case and eight weeks in the other. It was impossible to obtain material for examination in these cases. Figure 4 illustrates one of these cases.

The paucity of reported observations confirming Verhoeff's work has led some observers, especially in Europe, to disregard it entirely.

4. Dr. Verhoeff, who examined some of this material, disagrees with us as to the histologic picture and the significance of the gram-positive threads.

Junius,[5] in a recent review of ocular tularemia, discussed Parinaud's conjunctivitis as though it were a form of tularemia and dismissed the American observations with the words: "It will not be generally agreed that Leptothrix is the predominant (or indeed the only) cause of the disease described by Parinaud." Schieck [6] expressed the belief that the organisms described by Verhoeff are not the cause of the disease, but that the latter is perhaps due to tubercle bacilli of animal origin.

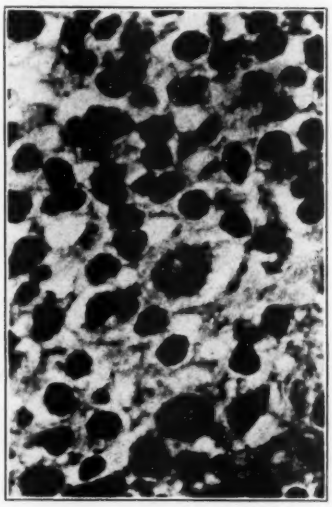

Fig. 3.—Section from granulation in right upper eyelid of patient, showing clump of granules and threads in a cell.

Fig. 4.—Appearance of a patient with conjunctivitis of the type described by the authors.

Several etiologic agents may produce a clinical picture greatly resembling that described by Parinaud. This fact was recognized by H. Gifford, Pascheff and others, who suggested that the term Parinaud's conjunctivitis describes merely a syndrome of signs and symptoms.

5. Junius, P.: Ztschr. f. Augenh. **78**:142, 1932.

6. Schieck, F., and Brückner, A.: Kurzes Handbuch der Ophthalmologie, Berlin, Julius Springer, 1931, p. 90.

The cause in Parinaud's original cases was not known, as the bacteriologic observations were negative. At least three causative agents have been found later in cases called by their observers Parinaud's conjunctivitis. In a few of these cases tubercle bacilli were demonstrated, and in many more the condition was considered to be tuberculosis without definite evidence. Verhoeff attempted to differentiate between conjunctival tuberculosis and Parinaud's conjunctivitis by the fact that in the latter condition no ulceration occurs and no caseation is seen in sections. He considers the small areas of focal necrosis with epithelioid phagocytosis as characteristic of Parinaud's conjunctivitis and as excluding tuberculosis. We have seen several cases of conjunctival tuberculosis, and they in no way resembled Parinaud's conjunctivitis. It may be possible, however, for tuberculosis to assume a clinical form greatly resembling the picture in this condition.

The oculoglandular form of tularemia may greatly resemble this picture. Here, however, there is nearly always a history of contact with wild rabbits or squirrels, and the general symptoms are usually much more severe. While there is fever in the first few days of Parinaud's conjunctivitis, the general symptoms are usually slight, and no fatal cases have been reported. Agglutination of the patient's serum for B. tularensis after the first week is characteristic, and such a test should always be made. In the three cases here reported this test gave negative results.

The group of cases described by von Herrenschwand and Bayer in which Bacillus pseudotuberculosis-rodentium was observed and that in which Pascheff saw an organism which he called Microbacillus polymorphus-necroticans were similar in regard to the clinical picture, and the organisms identified were related or perhaps identical. These were numerous, culturally somewhat similar to B. tularensis and very pathogenic for guinea-pigs. They are perhaps forms closely related to B. tularensis.

To any one who has examined Verhoeff's sections and ours there can be no doubt that a threadlike organism, a member of the group of Trichomycetes, was the causative agent in these cases. One of us has previously called attention to the fineness of the threads, their apparent branching in one case and the radial arrangement on one area, which suggested Streptothrix actinomyces rather than Leptothrix. The same suspicion is aroused by the radial arrangement seen in the case reported here (fig. 2). Unfortunately, however, we have been unable to cultivate organisms from these patients, and in view of the positive cultures of Verhoeff and King and the similarity of our sections to theirs in other respects, the name leptothricosis conjunctivae must be allowed to cover these cases as well as theirs.

The largest group of cases is that in which no organism was observed. In view of the difficulty of staining threads of Leptothrix in section, which has previously been referred to, it seems likely that the threads may have been present in a great many of these cases. At least the possibility cannot be denied for cases in which the results of inoculation into animals and cultures were negative, but in which Verhoeff's stain was not employed.

Since the name Parinaud's syndrome has long been employed to designate a neurologic condition (supranuclear paralysis of associated movements), it is suggested that the term conjunctivoglandular syndrome of Parinaud be employed for cases showing the clinical picture which he described and that the etiologic designation be given for the cases in which the agent can be determined. Agglutination tests with B. tularensis carried out as a routine, a differential blood count for eosinophilia, inoculations into guinea-pigs, cultures made according to the technic of Verhoeff and King and examination of sections carefully stained by Verhoeff's method will determine what proportion of cases belong in the group properly called leptothricosis conjunctivae.

MOVEMENTS OF EYES UNDER COVER

A ROENTGENOGRAPHIC STUDY

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In ophthalmologic practice one uses eyepads merely to protect the eyes and eye pads and bandages to apply pressure to the eyelids and to the eyeballs.

Although the textbooks and the journals describe various types of eye pads and bandages, nowhere were we able to find any record of a study of the movements of the eyes while they are padded or bandaged. From a priori reasoning, we may assume that if one eye only is covered the covered eye continues to move in the directions of the movements of the uncovered eye, and from the same reasoning we may assume that if both eyes are covered tightly with bandages, no movement, or very little, takes place. In sleep it has been observed that the eyes move up.

The following investigation was undertaken to study roentgenographically the movements of the eyes under cover. We were fortunate to have an intelligent subject for this study. He was 31 years of age, a mining engineer and a university graduate. He had done some research work and understood the importance of cooperation for this study.

The subject was first seen with a foreign body on the left cornea. This study was made two days later, after the removal of the foreign body, the eye at that time showing no disease. Vision was normal, and there was no refractive error. The backgrounds were normal. There was esophoria of 2 prism diopters for distance.

The study was made as follows:

Markers were placed on various parts of the eyeballs and on the skin just off the external canthi. Roentgenograms of the eyes in various positions were taken and compared with roentgenograms of the eyes padded or bandaged. The examination was made in one session, short periods being taken by the subject for rest.

A silver wire, about no. 18, was wound in a close helix about a mandrel about 1/16 inch (0.15 cm.) in diameter. Successive turns were cut off with scissors and straightened to form open rings. These were easily closed onto a tiny pinch of

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skin or conjunctiva, and they were retained well. On the completion of the test, they were easily removed by cutting the opposite portion of the ring with the tip of strong scissors, the two ends coming off easily.

The eyeballs were first thoroughly anesthetized with butyn, 2 per cent. The patient felt some discomfort during the test, but at no time did he have any pain. There was slight injection of the bulbar conjunctiva where the markers were applied for about three days after the test; otherwise no discomfort was felt.

Figure 1 shows diagrammatically the placement of the markers. They were applied to the bulbar conjunctiva at 3, 6 and 9 o'clock and about 2 mm. off the limbus. Markers were also applied to the skin at the external canthus, just off the last lower eyelash. The distance between the two horizontal markers in each eye, that is, between 3 and 9 o'clock, was 15 mm. The interpupillary distance, as measured between the markers on the two eyes, was 63 mm.

Five sets of roentgenograms were taken, and each set consisted of five pictures:

1. The first set consisted of pictures of ocular movements with the eyes uncovered. The first picture was taken with the subject looking with both eyes in the primary position and fixed for infinity (fig. 2); the second, looking to the

Fig. 1.—Diagram showing the various markers on the eyeballs. The markers were applied to the bulbar conjunctiva at 3, 6 and 9 o'clock and 2 mm. off the limbus and also to the skin just off the external canthi.

extreme right; the third, looking to the extreme left; the fourth, looking upward as far as possible; and the fifth, looking downward.

2. The second set consisted of pictures taken with an eye pad applied to the right eye. The pad was the usual type used in ophthalmologic practice. It consisted of cotton 5 mm. thick covered with one layer of gauze on each side and cut to a 6 cm. circle. The pad was applied to the eye by short adhesive plaster strips. The uncovered eye was kept open. Five pictures were taken with the pad over the right eye in the same positions as were used for the first set.

3. The third set consisted of five pictures, in the various positions, taken with a pad on the right eye and a bandage consisting of seven layers of gauze over the pad. At the time this set was taken the pad had been over the right eye for forty minutes and the bandage for twenty minutes. Five pictures were taken in the various positions.

4. The fourth set consisted of five pictures taken with pads on both eyes.

5. The fifth set consisted of five pictures taken with pads on both eyes and bandages over the pads.

Roentgenograms were taken simultaneously in anterior and lateral projections. The lateral views did not furnish much information not obtainable from anterior views alone. The pictures taken in the anterior projection were then studied.

The study consisted of observation of the relation of the positions of the eyes as shown by the distance between the various markers at the bulbar conjunctiva of each eye and also by their relation to the markers on the skin. The data were tabulated, and certain conclusions were drawn.

Throughout this study the distance between the two eyes, as measured by two markers, was considered as the interpupillary distance and was recorded in millimeters. When the interpupillary distance was found to have increased, as shown by the roentgenograms, this increase was considered as divergence of the eyes and recorded in millimeters. When there was a decrease in the interpupillary distance, the decrease was considered as convergence. The vertical and horizontal movements of the eyes were also recorded in millimeters. The wheel movement (rotation on the fronto-occipital axis) was estimated in degrees and designated as clockwise or counter-clockwise as seen by an observer facing the subject.

EFFECTS OF CHANGES IN POSITION OF EYES

Table 1 shows the changes produced by the various positions of the eyes.

Eyes Uncovered.—The interpupillary distance was 63 mm. (fig. 2). When looking to the extreme right, the eyes moved 8 mm.; the interpupillary distance was 65 mm., a divergence of 2 mm. When looking to the extreme left, the eyes moved 7 mm.; the interpupillary distance was 64 mm., a divergence of 1 mm. When looking up, the eyes moved 3 mm., with no change in the interpupillary distance. When looking down, the eyes moved 4 mm.; the interpupillary distance was 62 mm., a convergence of 1 mm.

There was a definite divergence when the eyes moved to the maximum in the horizontal plane: 2 mm. when looking to the right and 1 mm. when looking to the left. There was also a convergence of 1 mm. when the eyes looked downward.

Right Eye Covered with Pad, Left Eye Uncovered.—When looking to the right or left, there was a divergence of 1 mm. When looking down, there was a convergence of 0.5 mm., the right eye showing a counter-clockwise wheel rotation of 3 degrees, and the left, of 5 degrees.

Covering the right eye with a pad caused practically no change in the position of the eyes as compared with that of the eyes when uncovered. The counter-clockwise wheel rotation observed in both eyes when looking downward was due to the torsion of the eyes to the left.

Right Eye Covered with Pad and Bandage, Left Eye Uncovered.—In the primary position there was definite convergence of the eyes as compared with the picture when the eyes were uncovered or the right eye was padded. There was a definite limitation in movement when the eyes were moved to the right. In all other positions also there was a definite reduction in the interpupillary distance as compared with the findings with the eyes uncovered and with the right eye padded.

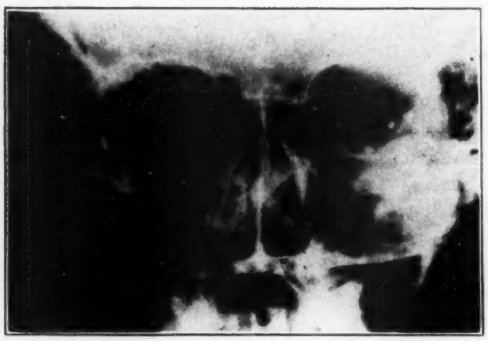

Fig. 2.—Roentgenogram showing the markers on the eyes. The eyes are uncovered and fixed in the primary position for infinity.

TABLE 1.—*Effects of Changes in Position of the Eyes*

Position	Interpupillary Distance, Mm.	Divergence, Mm.*	Distance Eyes Moved, Mm.*	Wheel Rotation of Eyes, Degrees†	
				Right	Left
Eyes uncovered					
Primary position.....	63	..	.....	..	..
Looking to right.....	65	2	8 to right	..	..
Looking to left.....	64	1	7 to left	..	..
Looking up.....	63	..	3 up	..	..
Looking down.....	62	1 of convergence	4 down	..	..
Right eye covered with pad					
Primary position.....	63	..	.....	..	..
Looking to right.....	64	1	9 to right	..	..
Looking to left.....	64	1	8 to left	..	..
Looking up.....	63	..	4 up	..	..
Looking down.....	62.5	0.5 of convergence	4 down and 2 to left	3	5
Right eye covered with bandage					
Primary position.....	61.5	..	.....	..	..
Looking to right.....	62	0.5	6 to right	..	..
Looking to left.....	63	1.5	8 to left	..	..
Looking up.....	62	0.5	5 up	..	..
Looking down.....	62.5	1	5 down	10	10
Both eyes covered with pads					
Primary position.....	61.5	..	.....	..	..
Looking to right.....	63.5	2	7 to right	5	5
Looking to left.....	64	2.5	9 to left	..	..
Looking up.....	63	1.5	5 up	..	..
Looking down.....	62	0.5	3 down	..	..
Both eyes covered with bandages					
Primary position.....	60.5	..	.....	..	..
Looking to right.....	60.5	..	5 to right and 1 up	..	..
Looking to left.....	60.5	..	6 to left and 3 up	..	5
Looking up.....	60.5	..	4 up	10	5
Looking down.....	60.5	..	5 down	..	..

* The divergence and the distance the eyes moved were calculated from the distance the eyes diverged or moved when compared with the positions of the eyes in the primary position.

† The wheel movement (rotation on the fronto-occipital axis) was estimated in degrees and designated as clockwise or counter-clockwise as seen by an observer facing the subject. In all of these observations the rotation was counter-clockwise.

Both Eyes Covered with Pads.—There was a definite divergence on looking in all directions as compared with the primary position (fig. 3). In the primary position, there was a convergence of 1.5 mm. as compared with the findings with the eyes uncovered. There was little difference in the movements of the eyes as compared with those observed when the right eye only was padded. However, there was more movement of the eyes than when the right eye was bandaged.

TABLE 2.—*Effects of Bandaging and Padding of the Eyes*

	Inter-pupillary Distance, Mm.	Convergence, Mm.*	Distance Eyes Moved, Mm.*	Wheel Rotation of Eyes, Degrees†	
				Right	Left
Eyes in primary position					
Eyes uncovered.....	63	..	.....	..	..
Right eye padded.....	63	..	.....	..	..
Right eye bandaged..	61.5	1.5	Right eye 2 up	5	..
Both eyes padded....	61.5	1.5	Right eye 1 down	3	..
Both eyes bandaged..	60.5	2.5	.....	10	..
Eyes turned to right					
Eyes uncovered.....	65	..	.....	..	..
Right eye padded.....	64	1	.....	5	5
Right eye bandaged..	62	3	.....	6	3
Both eyes padded....	63.5	1.5	.....	..	..
Both eyes bandaged..	60.5	4.5	2.5 up	10	..
Eyes turned to left					
Eyes uncovered.....	64	..	.....	..	..
Right eye padded.....	64	..	.....	..	..
Right eye bandaged..	63	1	.....	..	..
Both eyes padded....	64	..	.....	3	..
Both eyes bandaged..	60.5	3.5	5 up	2	5
Eyes looking up					
Eyes uncovered.....	63	..	.....	..	..
Right eye padded.....	63	..	2 up and a little to left	1 and counter-clockwise	..
Right eye bandaged..	62	1	.....	5	..
Both eyes padded....	63	..	1 up and a little to left	..	..
Both eyes bandaged..	60.5	2.5	2 up	..	..
Eyes looking down					
Eyes uncovered.....	62	..	.....	..	..
Right eye padded.....	62.5	0.5 of divergence	1 to left	..	..
Right eye bandaged..	62.5	0.5 of divergence	.....	..	3
Both eyes padded....	62	..	3 to right	10	5
Both eyes bandaged..	60.5	1.5	2 to left	3	3

* The convergence and the distance the eyes moved were calculated from the distance the eyes converged or moved when compared with the positions of the eyes uncovered.

† The wheel movement (rotation on fronto-occipital axis) was estimated in degrees and designated clockwise or counter-clockwise as seen by an observer facing the subject. In all of these observations the rotation was clockwise.

Both Eyes Covered with Pads and Bandages.—The interpupillary distance remained constant when the patient looked in the vertical and horizontal directions and was the same as in the primary position (fig. 4). The eyes did not move so far to the right (fig. 5) or left. There was an upward movement of the eyes when looking to the right or left. The vertical movements showed no change.

EFFECTS OF PADDING AND BANDAGING

Table 2 shows the effects of padding and bandaging with the eyes in the various positions.

Fig. 3.—Roentgenogram showing the markers on the eyes. Both eyes are covered with pads and look to the right.

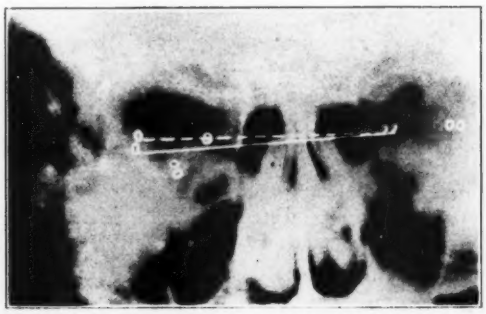

Fig. 4.—The uninterrupted line represents the interpupillary distance of the eyes uncovered and in the primary position (fig. 2). The interrupted line represents the interpupillary distance of the eyes bandaged. There is a definite decrease in the interpupillary distance, a convergence of 2.5 mm.

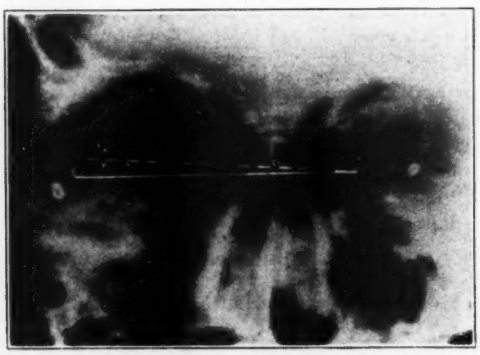

Fig. 5.—The uninterrupted line represents the interpupillary distance of the eyes covered with pads and looking to the right (fig. 3). The interrupted line represents the interpupillary distance of the eyes bandaged and looking to the right. There is a definite decrease in the interpupillary distance, a convergence of 3 mm.

Eyes in Primary Position.—Padding one eye had no effect on the interpupillary distance. Bandaging the right eye or padding both eyes caused the distance to be reduced to 61.5 mm. Further convergence was obtained by bandaging both eyes (fig. 4).

Eyes Looking to Right.—Little reduction in the interpupillary distance was obtained by padding either one or both eyes. A convergence of 3 mm. was obtained by bandaging the right eye, and a convergence of 4.5 mm. by bandaging both eyes (fig. 5).

Eyes Looking to Left.—No change in the interpupillary distance was obtained when one or both eyes were padded. A convergence of 1 mm. was present when the right eye was bandaged. A convergence of

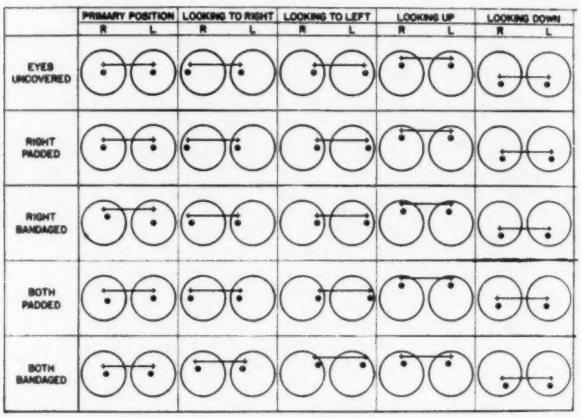

Fig. 6.—Diagram showing the eyes in the various positions. The dots in the center of the circles represent the pupils, and the distance between the dots is the interpupillary distance. The horizontal line above the dots represents the interpupillary distance of the eyes uncovered and in the primary position, which is 63 mm. The divergence and convergence of the eyes are shown by the relation of the dots to the horizontal line above them.

3.5 mm. took place when both eyes were bandaged, and the eyes were raised 5 mm.

Eyes Looking Up.—There was no change in the interpupillary distance when either one or both eyes were padded. There was a convergence of 1 mm. when the right eye was bandaged. There was a convergence of 2.5 mm. when both eyes were bandaged, and the eyes were raised 2 mm.

Eyes Looking Down.—There was practically no change when the right eye was padded or bandaged or when both eyes were padded. When both eyes were bandaged, there was a convergence of 1.5 mm.

COMMENT AND CONCLUSIONS

This study was undertaken to see just what happens to the movements of the eyes when they are padded or bandaged. Figure 6 gives a diagrammatic presentation of the various eye movements obtained.

There was practically no change in the interpupillary distance when the right eye was padded as compared with that when both eyes were uncovered.

Padding both eyes caused definite convergence in the primary position but had little effect otherwise.

TABLE 3.—*Changes in Interpupillary Distance in Various Positions*

		Interpupillary Distance in Mm.						
Subject	Age	Primary Position	Looking to Right	Divergence	Convergence	Looking to Left	Divergence	Convergence
1	8	58	58	(No change)		57	..	1
2	14	63	60	..	3	61	..	2
3	19	59	59	(No change)		59	(No change)	
4	24	66	65	..	1	66	(No change)	
5	25	59	58	..	1	58	..	1
6	28	58	59	1	..	59	1	..
7	28	71	71	(No change)		68	..	3
8	30	64	63	..	1	64	(No change)	
9	34	65	64	..	1	65	(No change)	
10	38	64	66	2	..	64	(No change)	
11	30	67	68	1	..	66	..	1
12	40	61	60	..	1	60	..	1
13	40	62	60	..	2	61	..	1
14	42	62	63	1	..	62	(No change)	
15	43	64	64	(No change)		65	1	..
16	45	62	63	1	..	61	..	1
17	45	60	59	..	1	60	(No change)	
18	50	68	67	..	1	69	1	..
19	50	58	56	..	2	57	..	1
20	50	58	57	..	1	58	(No change)	
21	55	62	61	..	1	61	..	1
22	57	63	60	..	3	60	..	3
23	60	61	60	..	1	60	..	1

* The interpupillary distance was measured with a Bausch and Lomb interpupillary gage.

Bandaging the right eye produced definite convergence in the primary position and some convergence in the other positions except on looking downward, when there was slight divergence.

Bandaging both eyes caused definite convergence. The interpupillary distance remained the same for all positions. When looking to the right or to the left the eyes moved upward.

When the eyes were uncovered there was divergence when looking to the right or left as compared with the findings with the eyes in the primary position. As we were unable to explain this observation, we undertook a study of the interpupillary distance in the various positions of the eyes in different persons. The interpupillary distance in the primary, right and left positions was measured by a competent optician

on twenty-three consecutive persons who came to have their ophthalmologists' prescriptions filled. Table 3 summarizes the figures obtained. Twenty-three persons were examined, varying in age from 8 to 60 years. In only one person did the interpupillary distance remain the same in the primary, right and left positions. In eleven, the distance increased or decreased in either the right or the left position as compared with the primary position. In eleven subjects the interpupillary distance

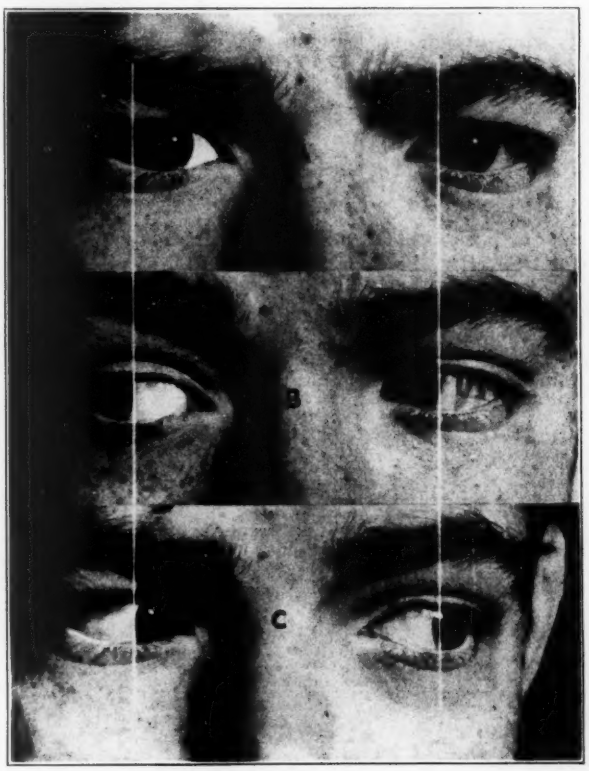

Fig. 7.—Photographs showing the eyes in various positions. *A* shows the eyes in the primary position; *B*, turned to the right. The interpupillary distance is the same in *A* and *B*, 61 mm. *C* depicts the eyes turned to the left. The interpupillary distance is 60 mm., a convergence of 1 mm. as compared with the interpupillary distance of the eyes in the primary and right positions.

in both the right and the left position differed from that in the primary position. The difference was either divergence or convergence and varied from 1 to 3 mm.

Photographic studies of the interpupillary distance were then undertaken. The eyes of three persons were photographed. The eyes were first dilated with homatropine, to reduce any tendency to accommodate.

The photographs of the eyes in the primary, right and left positions were then studied.

In one subject, aged 32, the interpupillary distance for all positions was the same, 54 mm. In the second subject, aged 35, the interpupillary distance for the primary and right positions was 60 mm. On looking to the left, the interpupillary distance was 61 mm., a divergence of 1 mm. In the third subject (fig. 7), aged 14, the interpupillary distance in the primary and in the right position was 61 mm. When looking to the left, the distance was 60 mm., a convergence of 1 mm.

No attempt is made in this paper to explain the different interpupillary distances found in the lateral positions as compared with the primary position.

We conclude that if it is desirable to have an eye or both eyes still and reduce the voluntary eye movements to a minimum, it is necessary to bandage both eyes. Of course, we realize that for practical purposes applying pads to both eyes limits the movements of the eyes, as with the eyes covered the patient has no point of fixation. However, there are occasions when it is essential that the ocular movements be abolished as far as possible, as in the treatment of a perforated wound of the cornea, after an operation for retinal detachment or keratoconus and in the treatment of a corneal ulcer with thinning of the floor of the ulcer and a tendency to bulge, etc. In such cases, bandaging of both eyes is recommended.

We further realize that one cannot draw dependable conclusions from one experiment on a single person. However, from the nature of this experiment, the difficulty of securing a proper subject or of repeating the same experiment on the same person is evident.

Nevertheless, the method that we used offers a new technic for the study of the various movements of the eyes.

SUMMARY

A roentgenographic study of the movements of the eyeballs under cover was made.

No change in the movements took place when one eye was padded.

Bandaging one eye caused definite convergence of the eyes in the primary position and some convergence in other positions.

Padding both eyes caused convergence in the primary position but little effect otherwise.

Bandaging both eyes caused definite convergence and definite limitation of movements in the horizontal directions.

The interpupillary distance when looking to the right or left, as a rule, differs from that in the primary position. It may show either

convergence or divergence. No attempt was made in this paper to explain the differences found.

When it is desired to limit the movements of an eye or of the eyes to a minimum, bandaging of both eyes is recommended.

The method described offers a new technic for the study of various eye movements.

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EXPERIMENTAL ENDOPHTHALMITIS PHACO-ANAPHYLACTICA IN RABBITS

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In 1922, Verhoeff and Lemoine [1] suggested that a certain type of postoperative intra-ocular inflammation following cataract extraction might be due to a reaction between retained lens substance and ocular tissues hypersensitive to lens substance. This suggestion was based on the fact that many of the persons with postoperative inflammation were sensitive to lens substance when tested by intracutaneous injections of lens extracts of human and animal origin. Normal persons tested with the same extracts did not react cutaneously. Verhoeff and Lemoine also found a characteristic histologic picture in the eyes removed after the development of the inflammation. In these eyes, the lenses were invaded by leukocytes and macrophages, and there were no demonstrable bacteria. For this type of intra-ocular inflammation they suggested the term, endophthalmitis phaco-anaphylactica. The foregoing hypothesis differs from that of Lagrange and Lacoste [2] and Straub [3] in that these writers postulate a primary toxicity of the retained lens substance. The latter suggestion has been accepted by Gifford [4] and others, or modified by those who believe the toxicity of the lens substance is partly due to bacteria acting on retained lens substance.

In attempting to reproduce the disease picture in animals, Verhoeff and Lemoine [1] were not successful. In a recent communication, Dr. Verhoeff stated: "We entirely failed to produce the phaco-anaphylactic reaction in rabbits."

The hypothesis concerning the hypersensitive etiology of endophthalmitis phaco-anaphylactica has had a considerable following, but its universal acceptance has been prevented largely by the failure of

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A preliminary report appeared in the *Proceedings of the Society for Experimental Biology and Medicine* (**31**:445, 1934).

From the Wilmer Ophthalmological Institute, Johns Hopkins Hospital and University.

1. Verhoeff, F. H., and Lemoine, A. N.: Endophthalmitis Phaco-Anaphylactica, Tr. Internat. Cong. Ophth., 1922, p. 234.

2. Lagrange, H., and Lacoste, A.: Des complications subaiguës et tardives après l'operation de la cataracte, Arch. d'opht. **31**:769, 1911.

3. Straub, M., cited by Verhoeff and Lemoine.[1]

4. Gifford, S. R.: Allergic and Toxic Properties of Lens Protein, J. A. M. A. **85**:351 (Aug. 1) 1925.

attempts to reproduce the disease experimentally. Since 1922, to my knowledge, not one confirming report has appeared. Braun,[5] in particular, has denied the truth of this theory because he was unable to produce precipitins for, or to sensitize animals to, lens substance. He offers evidence to show a primary toxicity of lens substance. Since Uhlenhuth's[6] original announcement of the organ specificity of lens protein, proved by the production of precipitins for this substance, numerous confirming reports of this fact have appeared. However, few workers have reported the development of anaphylactic or hypersensitive states in the rabbit, and an analysis of such studies leaves one in doubt as to whether the acute deaths reported were anaphylactic or anaphylactoid, for an acute anaphylactic death in the rabbit is extremely difficult to bring about even with the most active antigens. My personal observations, extending over a period of eight years, indicate that it is extremely difficult, if at all possible, to develop an anaphylactic state in the rabbit with lens extracts. To my knowledge, no one has reported the development of an Arthus reaction to lens substance in the rabbit.

The literature on the subject of endophthalmitis phaco-anaphylactica can be briefly summarized as follows: Postoperative intra-ocular inflammation with a characteristic histologic picture is found in persons whose skin is sensitive to lens extracts. Attempts to produce a similar picture in rabbits have thus far been unsuccessful, although precipitins for lens substance can be developed in this animal.

In a previous report[7] it was shown that rabbits given intracutaneous injections of staphylococcus toxin developed not only an antitoxin for the toxin, but also a hypersensitive state to the beef broth in which the toxin is produced. Beef broth does not ordinarily have any such antigenic effect. It occurred to me that if such a poor antigen as beef broth could be made active by the intermediary action of staphylococcus toxin, the toxin might have a similar action on lens substance. Accordingly, the following experiments were undertaken, and it is believed that the results confirm the hypothesis of Verhoeff and Lemoine[1] concerning the allergic nature of endophthalmitis phaco-anaphylactica, and that this allergic state can be attained by the action of a bacterial toxin.

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5. Braun, R.: Immunbiologische Untersuchungen zur Frage der Ueberempfindlichkeit gegen Linseneiweiss bei Mensch und Tier, Arch. f. Augenh. **105**:122, 1931; Ueber eine primäre Giftwirkung der Linsensubstanz und ihren Einfluss auf anaphylaktische Experimente, ibid. **106**:99, 1932.

6. Uhlenhuth, P.: Zur Lehre von der Unterscheidung verschiedener Eiweissarten mit Hilfe spezifischer Sera, Festschr. 3, Sechzigsten Geburt. v. Robert Koch, Jena, 1903, Gustav Fischer, p. 49.

7. Burky, E. L.: Antitoxin Content of Rabbit Serums Immune to Staphylococcus Toxin and the Precipitin Reactions of Such Serums, J. Immunol. **25**:419, 1933.

MATERIALS AND METHODS

Lens Extract.—Beef eyes, fresh from the slaughter house, were opened with a transverse corneal incision. Through this opening the lens was expressed into hundredth-normal ammonium hydroxide containing 0.5 per cent cresol. Twenty cubic centimeters of this solution was used for each lens. After it was shaken for twelve hours with broken glass, the resulting emulsion was centrifugated and filtered through a Berkefeld V filter. Total solids were determined by dehydrating at 104 C. The solution was then adjusted to contain 2 per cent protein and 0.85 per cent sodium chloride by adding sterile distilled water and 8.5 per cent solution of sodium chloride. Lens extracts from other species were prepared in a similar manner. Such solutions of lens when injected intravenously into rabbits in amounts as large as 10 cc. do not cause any demonstrable toxic effects. Repeated intravenous injections produce precipitins for lens solutions from all species. Injected intracutaneously (0.1 cc.), they do not produce cutaneous reactions or precipitins in normal human beings or in rabbits.

Lens Broth[8] *Toxin.*—Beef eyes, fresh from the slaughter house, were trimmed of all extra-ocular tissue and dropped into boiling water for thirty seconds. With a sterile scissors, a transverse corneal incision was made and the lens expressed into a tube containing 20 cc. of hormone bouillon. Fifty tubes were prepared and incubated for one week, the temperature being alternated from room temperature to 37 C. About half of the tubes were contaminated. These were discarded, and the remainder were inoculated with Staphylococcus aureus, toxin-forming strain Ha. After ten days' incubation at 37 C., the contents of the tubes were pooled, 0.5 per cent cresol being added, and the solution filtered through a Berkefeld V filter. The staphylococci slowly disintegrate the lens substances, so that a relatively undamaged lens becomes an amorphous mass of sediment after ten days' incubation. The foregoing filtrate killed adult rabbits in twenty-four hours or less after the intravenous injection of 0.1 cc. per kilogram of body weight. This filtrate precipitated with staphylococcus-precipitating serum in dilutions as high as 1:16 and with lens-precipitating serum in dilutions as high as 1:50,000. With the latter figure as a guide, it is estimated that undamaged or reactive lens substance was present in a concentration of about 1 per cent. Filtrates of staphylococcus strains Fs and Dl were prepared in the same way. These filtrates were not toxic for rabbits.

Staphylococcus Filtrates, Toxic and Nontoxic.—Staphylococcus strains Ha, Fs and Dl were inoculated to hormone bouillon without lens substance and put through the procedure described. A brief résumé of their properties will be given. The full details have been reported elsewhere.[7] Whole cultures and filtrates of strain Ha kill rabbits in twenty-four hours or less after the intravenous injection of small amounts (0.1 cc. per kilogram of body weight). Death is apparently due to the action of a true exotoxin. Similar strains have killed human beings after the injection of small amounts of culture[9] and have caused severe gastro-intestinal

8. The term "lens broth" is used to indicate the medium in which the toxin is produced. It is not meant to imply that the lens itself has been made toxic.

9. Burnet, F. M.: The Exotoxins of Staphylococcus Pyogenes Aureus, J. Path. & Bact. **32**:717, 1929.

symptoms after oral ingestion.[10] The pathologic process in human beings and in rabbits is essentially the same.[7] This strain was isolated from a case of severe chronic blepharitis. Whole cultures of strain Fa kill rabbits with abscess formation later than twenty-four or forty-eight hours after intravenous injection. Filtrates have no pathogenic action. This strain was isolated from a case of recurrent styes. It resembles other human strains isolated from lesions such as osteomyelitis. Strain Dl was isolated from a normal human conjunctiva and has no pathogenic effect on rabbits. All of these filtrates cause erythema and swelling when injected intracutaneously into human beings and rabbits. The most marked reaction is produced by filtrate Ha and the least reaction by filtrate Dl.

Rabbits.—Nine rabbits were prepared for intracutaneous injection by depilation with barium sulphide. At intervals of one week, each rabbit received in one cutaneous area 0.1 cc. of lens broth toxin and in another area 0.1 cc. of lens extract. Reactions were recorded by measuring the maximum diameters of erythema and swelling and necrosis in centimeters. Two rabbits were given intravenous injections of lens extract (5 cc.) each week.

Preceding the first injections and at irregular intervals thereafter, serum for precipitin tests was collected by bleeding from the marginal vein of the ear. Tests were done immediately after the collection of the serums, or the serums were preserved with chloroform for subsequent use. Dilutions of lens extracts as high as 1:100,000 were layered over the serums, and the ring reaction was read at the end of one hour. The tubes were then shaken and incubated at 37 C. for one hour. Final readings were made the following day.

RESULTS

Cutaneous Reactions to Lens Broth Toxin.—This filtrate produced reactions like those produced by plain bouillon toxin.[7] The first injection was followed by erythema and swelling which appeared twenty-four or forty-eight hours after injection. Necrosis occurred in the majority of the animals, and the necrotic crusts were present for as long as three weeks. Subsequent injections caused lesser reactions until a minimum was reached (1 by 1 cm. in from four to twenty-four hours). Following this state of relative nonreactivity, further injections caused a marked increase in the size of the reaction. The time of appearance was shortened to four hours, and the erythema and swelling persisted for as long as forty-eight hours. Necrosis was absent or minimal.

10. The following papers deal with food poisoning in human beings caused by staphylococci: Barber, M. A.: Milk Poisonnig Due to a Type of Staphylococci Albus Occurring in the Udder of a Healthy Cow, Philippine J. Sc. **9**:515, 1914. Dack, G. M.; Cary, W. E.; Woolpert, O., and Wiggers, H.: Outbreak of Food Poisoning Proved to Be Due to Yellow Hemolytic Staphylococcus, J. Prev. Med. 4:167, 1930. Jordon, E. O.: Production by Staphylococci of Substance Causing Food Poisoning, J. A. M. A. **94**:1647 (May 24) 1930. Ramsey, R. J., and Tracy, P. H.: Proc. Soc. Exper. Biol. & Med. **28**:390, 1931.

Cutaneous Reactions to Lens Extract.—The initial injection of this substance into normal and experimental rabbits caused transient swelling and little or no erythema. The reactions never exceeded 2 by 2 cm. and disappeared within twenty-four hours. Repeated injections into normal animals or into the rabbits given intravenous injections of lens extract produced similar or lesser reactions. In the group of rabbits given injections of lens broth toxin and lens extract, the latter substance caused "normal" cutaneous reactions until the sudden increase in the reactivity of the skin described occurred. At this time the reactions caused by lens broth toxin and lens extract could not be distinguished from each other. It was concluded that both reactions were due to the lens extract rather than to the toxin.[11] The rabbits were then tested with human, swine and rabbit lens extracts and found to be equally reactive.

The first appearance and duration of sensitivity to lens extract varied in different animals, but the majority attained the maximum reactivity after the fourth injection, and the sensitivity persisted through several further injections. One rabbit in this group did not react until after the sixth injection. Two rabbits, sensitive after the third or fourth injections, were relatively nonreactive after the fifth injection.

Ocular Reactions.—To determine whether the sensitivity to lens substance was widespread and specific, the following experiment was done on the rabbits into which lens extract and lens broth toxin were injected intracutaneously, on the rabbits into which lens extract was injected intravenously and on four normal control rabbits. Under cocaine anesthesia, a 25 gage needle attached to a syringe was inserted into the anterior chamber, and about 0.2 cc. of aqueous humor was drawn into the syringe. The needle was then thrust into the lens and the aqueous humor injected. The reactions that followed are described later [12] and are summarized in the table according to the previous treatment of the animals. In the text the results are divided into groups on the basis of the ocular reactions.

A. Normal Rabbits.—(*a*) Rabbits 12 and 15 showed a purely traumatic response to the needling. There were moderate conjunctival and pericorneal injection, plasma exudate in the anterior chamber and

11. In other experiments animals given injections of lens broth toxin or plain broth toxin were tested cutaneously with a toxin, produced in rabbit muscle broth, when the increase in the cutaneous reaction occurred. This toxin caused no cutaneous reactions, which further shows that the increased reaction is due to some constituent of the broth.

12. Dr. Jonas Friedenwald also made clinical and histologic studies on these eyes. In addition to my own observations, he examined the eyes without any knowledge of the previous treatment of the rabbits.

traumatic cataract. These eyes, except for opacities of the lens, were normal within three or four days. The histologic examination gave negative results.

(*b*) Rabbits 13 and 14 were believed to be secondarily infected. In addition to the foregoing changes, there was a purulent discharge from the conjunctiva. These eyes, except for opacities of the lens and external inflammation, were normal within seven days. Histologic study of the eye of rabbit 14 showed nothing remarkable. Rabbit 13 showed

Summary of Ocular Reactions

Rabbit	Lens Needled After Injections	Cutaneous Sensitivity to Lens Extract at Time of Needling	Ocular Reaction		Day of Enucleation	Precipitin Titer at Time of Needling
			Clinical*	Histologic		
Group I: Lens Broth Toxin and Lens Extract Injected Intracutaneously						
1	5	Waning†	Pos.	Doubtful pos.	15	50,000
2	5	Waning	Pos.	Doubtful pos.	15	50,000
3	4	Pos.	Pos.	Not removed	..	50,000
4	4	Pos.	Pos.	Not removed	..	50,000
5	4	Pos.	Pos.	Pos.	15	50,000
6	4	Pos.	Pos.	Hemorrhage‡	2	50,000
7	4	Pos.	Pos.	Pos.	15	50,000
8	4	Pos.	Pos.	Pos.	8	50,000
9	4	Neg.	Trauma	Neg.	15	50,000
Group II: Lens Extract Injected Intravenously						
10	4	Neg.	Trauma	Negative	15	5,000
11	4	Neg.	Trauma	Not removed	..	5,000
Group III: Normal Rabbits						
12	0	Not tested	Trauma	Neg.	2	0
13	0	Not tested	Infected‖	Pos.#	15	0
14	0	Not tested	Infected‖	Neg.	15	0
15	0	Not tested	Trauma	Neg.	15	0

* Positive: phaco-anaphylactica, as shown by palpebral and conjunctival injection, pericorneal injection, scleral necrosis, corneal haze with late vascularization, opalescent aqueous beam, iritis, synechia and opacities of the lens.

† Waning: previous positive cutaneous reaction to lens extract but only weakly positive at time of needling.

‡ This rabbit showed the most intense reaction after needling. Within forty-eight hours there was a necrotic rim about the cornea 2 mm. wide. It was thought that the eye would rupture, and enucleation was attempted. The eye ruptured while it was being removed. The entire picture, histologically, was obscured by hemorrhage throughout the eye. Bacteria were not found.

‖ The clinical picture in these eyes was much like the one described in the star footnote. In addition, there were hypopyon and a purulent discharge. Cultures from the discharge showed toxin-forming Staph. aureus and a gram-negative rod thought to be the snuffles organism.

See the discussion in the text.

a typical picture of endophthalmitis phaco-anaphylactica. A toxin-forming Staph. aureus was isolated from the discharge from this eye when the purulent discharge was marked.

B. Lens-Insensitive, Precipitin-Positive Rabbits.—This group includes rabbits 10 and 11, into which intravenous injections of lens extract were made, and rabbit 9, into which intracutaneous injections of lens broth toxin and lens extract were made, which were not cutaneously reactive at the time of needling. This group acted like the normal control group with one possible exception. It is my impression that

the opacities of the lens disappeared more rapidly in this group than they did in the normal control animals. Whether absorption was hastened cannot be definitely stated, but it is certain that subsequent injections of lens extract did not cause any ocular flare-ups such as were seen in certain rabbits to be described later. Histologic study of these eyes showed no evidence of endophthalmitis phaco-anaphylactica. At the time of needling, the precipitin titer of this group did not exceed 1 : 5,000.

C. Lens-Sensitive, Precipitin-Positive Rabbits.—Needling of the lens of this group of rabbits caused a hypersensitive type of reaction like that occurring after the injection of beef serum into the eye of a rabbit sensitive to this serum.[13] Within twenty-four hours there were marked conjunctival injection and edema. The corneas were steamy; the opalescent aqueous beam was strongly positive, and in some instances, a plastic iritis obscured the state of the lens. After several days the corneas were invaded by vascular loops. Rabbits 5, 6 and 7 had necrotic bands about 2 mm. wide at the limbus. In rabbit 6 the necrosis was so marked that it was thought that the eye would rupture. To prevent this, enucleation was attempted forty-eight hours after the needling, but the eye ruptured while it was being removed. The histologic picture was obscured by fresh hemorrhage. The reactions of the remainder of the eyes persisted for seven days or longer and subsequent intracutaneous injections of lens broth toxin and lens extract caused an increase in the ocular symptoms if the animal was still reactive cutaneously to lens extract. Histologic examination of these eyes showed the typical picture of endophthalmitis phaco-anaphylactica except in rabbits 1 and 2. These animals were entering a desensitized state when the needling was done. At the time of needling the precipitin titers were 1 : 50,000 or more.

Pathologic Report (Dr. Jonas Friedenwald).—The eyes of the sensitized rabbits were enucleated at varying intervals for histologic study. For comparison, a similar group of nonsensitized rabbits were subjected to the same injury and their eyes enucleated at corresponding intervals. Care was taken in the choice of controls to compare the eyes which in the allergic series showed the most severe clinical reactions with those in the nonallergic series which showed the most reaction to trauma alone.

The characteristic pictures of the reactions found in the allergic series may be summarized as follows: During the first twenty-four to forty-eight hours after injury to the lens these eyes showed evidence of a marked intra-ocular vasomotor reaction. The anterior chamber

13. Burky, E. L: Relation of Ocular Sensitivity to the Arthus Phenomenon in the Rabbit, Arch. Ophth. **10**:368 (Sept.) 1933.

and, to a lesser degree, the vitreous cavity were infiltrated with serum proteins. The iris and ciliary body were edematous and their vessels congested. The cellular infiltration was remarkably scanty, a fact which may be taken as evidence of the relative rarity of accidental infection in these groups. The control eyes enucleated at the same interval following needling showed the same type of reaction but to a much less degree, except in one instance. This eye was obviously infected and showed an extensive polymorphonuclear infiltration of all of the anterior ocular tissues.

One week after the injury the eyes of the sensitized group showed a marked inflammatory reaction. The cornea was vascularized and infiltrated with wandering cells. In several instances there was an intercalary staphyloma of the sclera which occurred at some distance from the puncture hole of the traumatizing needle. The anterior chamber was filled with serum and wandering cells. The iris was adherent to the lens by fibrinous synechia, its stroma infiltrated with wandering cells which were also deposited in considerable numbers on its anterior surface. The lens was swollen and autolyzed, and macrocytes could be seen within the lens substance, each macrocyte surrounded by a small halo of apparently digested material. The vitreous was infiltrated with serum and cells. There were cellular deposits on the surface of the retina and optic disk and some perivascular infiltration within these tissues. The choroid, as a rule, showed no abnormalities. The character of the cellular reactions is of some value in distinguishing the findings in the allergic animals from those in accidentally infected control animals. In the latter, when the reaction was comparable in severity to that in the allergic animals, which generally was not the case, the infiltrating cells were predominantly polymorphonuclear, while in the allergic animals the infiltration was predominantly monocytic. In uninfected control animails, i. e., those that did not show polymorphonuclear infiltration, the amount of infiltration was insignificant in comparison to that found in allergic animals. One sensitized animal was apparently also accidentally infected and showed both monocytic and polymorphonuclear infiltration.

The reaction at the end of two weeks showed essentially the same characteristics. The eyes of the allergic animals were, if anything, more intensely infiltrated with monocytic cells than at the end of one week, while in the control animals the reaction was subsiding.

Though definite differences were found between the ocular reactions of the allergic and the nonallergic animals to similar trauma to the lens, it must be pointed out that the histologic picture in the allergic animals was not precisely similar, either in character or in degree, to that generally seen in human eyes showing what is presumed to be a phacoanaphylactic endophthalmitis. Whether the differences are due to the

shorter duration of the experimental disease, to a difference in the reactivity of the species or to some other factor remains for future study to answer.

Precipitins.—The serums of all animals were examined for lens precipitins before the experiment was begun and were found to be negative. Precipitin titers in the group given intravenous injections did not exceed 1 : 5,000 at the time of needling and after the administration of 20 cc. of lens extract. The sensitive animals had precipitin titers of 1 : 50,000 or more after the fourth injection and the administration of not more than 1 cc. of lens extract.

While I do not believe that the high precipitin titer is responsible for the hypersensitive ocular reaction, the high concentration of precipitins produced by minimal amounts of lens extract suggests that the antigenic activity of lens extract has been increased by the action of the toxin. Ordinarily, the amount of lens extract used in the group C animals would produce no demonstrable effect. For example, preceding this study, the same preparation of lens extract was injected intracutaneously, alone or mixed with beef serum into four rabbits without producing precipitins or sensitivity to lens substance after eight injections. The beef serum, however, produced a typical Arthus phenomenon and precipitins for beef serum.

These results show that a sensitivity to lens substance can be developed by combining lens substance with staphylococcus toxin. The following experiments were done to answer, if possible, some of the questions suggested by the foregoing observations.

Rabbits 16, 17 and 18 were given injections as previously described of a mixture of 2 per cent lens extract and beef broth toxin in one cutaneous area and lens extract in another area. Rabbits 19, 20 and 21 were given injections of 2 per cent lens extract in one cutaneous area and beef broth toxin in another area.

A cutaneous and ocular sensitivity to lens substance developed in one rabbit in each group (17 and 20). The characteristic histologic picture was found in these eyes after needling. The precipitin titers of the two animals were between 1 : 5,000 and 1 : 50,000. The other four rabbits did not react cutaneously. The ocular reactions were doubtful clinically, and histologically the eyes did not show any evidence of endophthalmitis phaco-anaphylactica. Precipitins were not found in two of the rabbits, and the other two had titers less than 1 : 5,000.

These results show that coincident injections of lens extract and beef broth toxin can produce a sensitivity to lens substance. However, this method is not so effective as the one first described. The results suggest that the sensitivity develops to unaltered lens substance rather than to some split protein derived from the lens and produced by the

metabolic activities of staphylococci. They also add evidence to the previous suggestion that the toxin alters or raises the antigenic effect of lens.

Rabbits 22, 23 and 24 were coincidentally given injections of nontoxic lens broth filtrate Fs and of lens extract. Rabbits 25, 26 and 27 were similarly given injections of nontoxic lens broth filtrate D1 and lens extract. All other details of technic have been previously described. Repeated injections of these filtrates produced doubtful cutaneous reactions in rabbits 22 and 27. Needling produced only a traumatic reaction, and histologic study showed no evidence of endophthalmitis phaco-anaphylactica. Precipitins for lens did not appear in any of this group.

The results suggest that toxin-forming staphylococci are the only strains of this species that can produce a sensitivity to lens substance. They also show that the intracutaneous injection of lens substance without toxin will not produce precipitins.

It was mentioned earlier in this report that lens broth filtrates Fs and D1 were nontoxic for rabbits. These two strains, however, reduced the lenses to an amorphous mass like that produced by strain Ha. This result implies some destruction of the lens with the formation of split products. If such split products are formed they do not have any lethal or sensitizing effects, and it would appear, therefore, that the toxicity and sensitizing effect of filtrate Ha is a specific one, inherent only in toxin-forming strains.

The lenses of the rabbits which developed a specific ocular reaction in all of the preceding experiments were needled when the cutaneous sensitivity was at or near its peak. The ocular reaction was immediate and severe and differed from the picture in human beings in that it appeared immediately after the needlings. In an attempt to duplicate the delayed appearance, the eyes of rabbits 28 to 33 were needled on the day the initial intracutaneous injections of lens broth toxin and lens extract were made. The needlings caused "normal" reactions the first few days, but these eyes did not return to normal. The ocular reactions slowly increased, and after each subsequent intracutaneous injection there was a further increase. The clinical picture in these eyes resembled closely the one seen in human eyes. The cutaneous reactions to lens extract alone were positive after the third injection, and the precipitin titers were greater than 1 : 5,000. The eyes were removed after the third intracutaneous injections, and histologic study confirmed the clinical diagnosis of endophthalmitis phaco-anaphylactica.

COMMENT

These results show that hypersensitivity to lens substance can be produced experimentally in rabbits by the intermediary action of staphylococcus toxin, and that when the lenses of such lens-sensitive

rabbits are needled, endophthalmitis phaco-anaphylactica results. The results suggest, but do not show, how the clinical picture develops in human beings. The pathogenic actions of staphylococcus toxin in human beings and in rabbits are so essentially alike in other respects that it seems safe to suggest that sensitivity to lens, in some instances at least, might be brought about by the action of toxin from a focus of infection or by the actual infection of the eye by toxin-forming bacteria at the time the lens is being absorbed after an operation. Such a mechanism might be proved in rabbits, but such an experiment would require an extremely large number of animals because of the large number of variables inherent in such an experiment. To prove such a mechanism of endophthalmitis phaco-anaphylactica in human beings seems impossible at the present time.

SUMMARY

Cutaneous sensitivity to lens substance in rabbits can be produced by repeated and coincident injections of staphylococcus toxin and lens substance. When the eyes of such sensitive rabbits are needled, a clinical and histologic picture develops which resembles endophthalmitis phaco-anaphylactica in man.

OCULAR LESIONS RESULTING FROM THALLIUM ACETATE POISONING AS DETERMINED BY EXPERIMENTAL RESEARCH

CHARLES MARION SWAB, M.D.
OMAHA

During the past few years there have been frequent references in medical publications to cases of thallium poisoning. Among these are reports submitted by ophthalmologists, who showed by various clinical methods that the visual disturbances caused by thallium intoxication were due to inflammation of the optic nerve. In some instances there was early evidence of involvement of the optic nerve; in others, the visual apparatus was affected rather late in the course of the intoxication; in a few cases there were no visual symptoms. Writers are agreed that large doses of thallium are harmful to the optic nerve; moreover, they are of the opinion that visual symptoms may result from repeated smaller doses. On account of the slow elimination of thallium by the excretory organs of the body, it is assumed that toxic effects often occur as the result of accumulation.

My interest in the question of the extent of the damage that might occur in the eyes and their adnexa, owing to the effect of thallium, grew out of the fact that it presented a problem for experimental research. This interest was still further stimulated when Ginsburg and Nixon [1] recorded an outbreak of thallium poisoning in which one or more of the following symptoms were found in several cases: conjunctivitis, ptosis, strabismus and mydriasis. Another incentive for undertaking the problem was the fact that even when autopsies were performed the pathologic changes in the visual apparatus were surmised rather than proved. It was therefore decided to study the histopathologic changes induced by thallium poisoning in the eye, the optic nerve and the central connections of the latter. Before setting forth the results of these detailed studies it seems fitting to review certain phases of the subject as a whole.

Read before the Section on Ophthalmology at the Eighty-Fifth Annual Session of the American Medical Association, Cleveland, June 13, 1934.

Thesis submitted to the Faculty of Ophthalmology of the Graduate School of Medicine of the University of Pennsylvania in partial fulfilment of the requirements for the degree of Master of Medical Science (M. Sc. [Med.]) for graduate work in ophthalmology.

1. Ginsburg, H. M., and Nixon, C. E.: Thallium Poisoning, J. A. M. A. **98**:1076 (March 26) 1932.

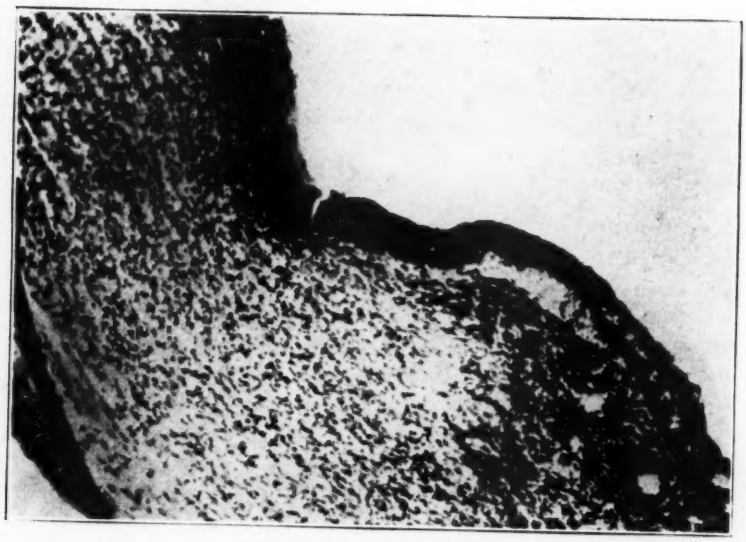

Fig. 1.—Infiltration in the conjunctiva. Low power.

Fig. 2.—Ulcer of the cornea. Low power.

In 1861, Crookes [2] discovered the element thallium by means of the spectroscope. Thallium shows a green line in the spectrum and, according to Olmer and Tian,[3] is detectable in quantities as small as 2 micrograms per liter, a dilution of 1 : 500,000,000. Although a number of salts have been made from thallium, those which are more commonly in use are the sulphate and the acetate. The sulphate is in demand chiefly as the effective ingredient in preparations for rodent poison. In medical practice the acetate once found place in the treatment of colitis and was even considered as an effective agent in checking the night sweats in tuberculosis. It has been employed, too, as a depilatory, and has been administered both internally and externally for hypertrichiasis, ringworm of the scalp and other forms of tinea. The depilatory action of thallium has been known for many years, but once its toxic effects were recognized by physicians its use was discouraged. Even now, however, it is utilized by some dermatologists as a depilatory agent. Their contention is that it is not harmful when given in small doses, and thus administered it is capable of producing the desired therapeutic effect. Most physicians agree with Sollmann [4] concerning thallium, namely, that: "The therapeutic use has repeatedly caused severe poisoning and is scarcely justified." Many of the cases that have been reported during the past three years have resulted from the use of a proprietary cosmetic depilatory known as Koremlu Cream.

EXPERIMENTAL WORK

In the desire to obtain first-hand ocular evidence of the deleterious effects of thallium, a series of experiments was begun early in the fall of 1932 and has been continued until the present time. These experimental studies were conducted in the department of pharmacology of the Medical School of Creighton University, where I had the cooperation and direction of Dr. H. F. Gerald, head of the department. Dogs and rabbits were selected for the studies in which the histopathologic changes were to be elaborated. Other data, however, were tabulated after feeding experiments with rats; this material was to be made use of in determining the toxicologic effects of small doses of thallium. As is usual in research of this nature, new problems arose as the work progressed and as the contributions of others were more fully studied.

2. Crookes, William: Biographical Sketch, Encyclopedia Britannica, ed. 11, 1910, vol. 7, p. 501.

3. Olmer, D., and Tian, A.: Intoxication par l'acétate de thallium. Présence de thallium dans le liquide cephalo-rachidien, Compt. rend. Acad. d. sc. **57**:494, 1908; quoted by Munch, J. C.: The Toxicity of Thallium Sulphate, J. Am. Pharm. A. **17**:1086, 1928.

4. Sollmann, T.: Manual of Pharmacology, ed. 3, Philadelphia, W. B. Saunders Company, 1927.

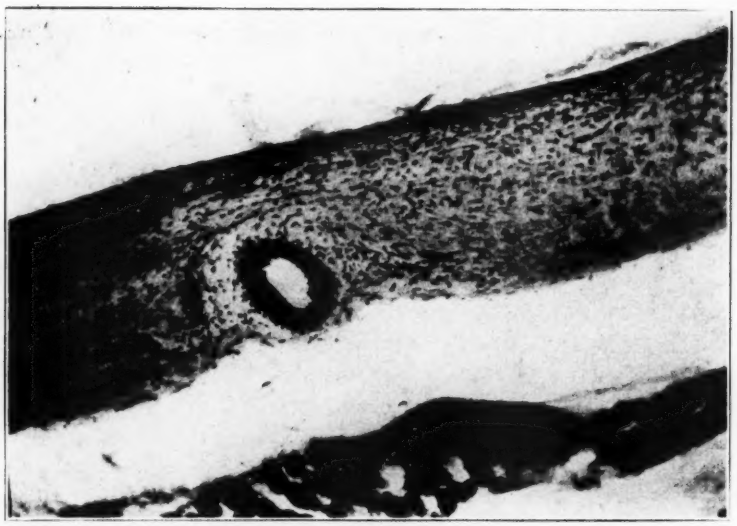

Fig. 3.—Perivascular round cell infiltration in the sclera. Low power.

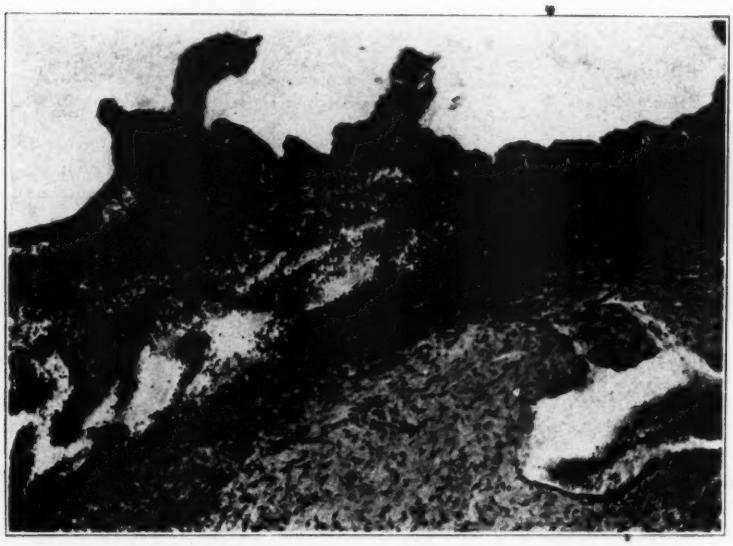

Fig. 4.—Abscess in the ciliary body. Low power.

In consequence, it was deemed better to restrict the field of the investigations until some of the histologic data could be tabulated and analyzed.

In the case of both the rabbits and the dogs a solution of thallium acetate, one fourth of the lethal dose,[5] was injected subcutaneously. With this small dosage it seemed more likely that the animals would survive for a period long enough to allow degenerative changes to develop. It was necessary, too, to feel our way in order to find out if subsequent doses would be required. Six dogs and five rabbits were used. One rabbit was treated with a 7 per cent thallium acetate ointment applied by inunction over a period of five days. Control animals were always at hand to aid in the evaluation of symptoms. Three rabbits required a second administration of the intoxicant before severe symptoms were induced. Some toxic symptoms developed in each by the third or fourth day, but the symptoms were seemingly overcome by the end of a week. The other dogs and rabbits of this group would have succumbed to the initial injection had they not been chloroformed or etherized when it was apparent that they could not survive. One dog died during the night, and autopsy was not performed since great care had been exercised in order to rule out postmortem degeneration. The rabbit treated with thallium acetate ointment was allowed to die on the tenth day merely to demonstrate that this method of administration is rapidly fatal to laboratory animals.

For the second group of experiments white rats were chosen. It was thought that albino eyes would reveal pathologic changes of the anterior segment more easily than would be the case with dark eyed rats. Accordingly, seven white rats were placed in seven separate cages, each cage containing another rat of the same size. A partition was inserted into each cage so that the control animals could not get at the food, baits or drinking water of the subject rats.

PROTOCOLS

May 17: Each rat was given 1 cc. of 1:10,000 solution of thallium acetate on bread.

May 18, 19, 20, 22, 24, 25, 26 and 29: Similar baits were given.

June 1, 3, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, 19, 21, 22, 23, 24, 26, 27, 28, 29 and 30: This procedure was continued.

July 1, 3, 5, 6, 7, 8, 10 and 11: The same method was pursued.

July 11: As the rats showed no symptoms, the thallium acetate content was raised to a strength of 1:1,000 solution.

July 12, 13, 14, 15 and 17: This solution was given in quantities of 1 cc. each day.

5. The fatal dose for a number of animals has been established; by means of such dosage a given animal will die in from twenty-four to seventy-two hours. The lethal dose has been determined for oral, subcutaneous and intravenous administration (Sollmann, T., and Hanzlik, P. J.: An Introduction to Experimental Pharmacology, Philadelphia, W. B. Saunders Company, 1928).

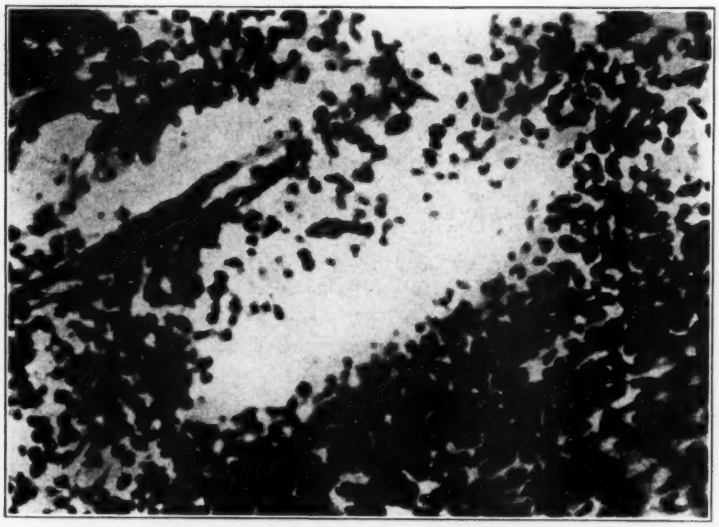

Fig. 5.—High power view of figure 4. The leukocytes are so dense that the character of the individual cells is made out with difficulty.

Fig. 6.—Round cell infiltration in the optic papilla. Low power.

July 18: The rats stopped eating; the fur was rough, but there was no shedding; all exhibited signs of weakness. One rat died in the morning; the eyeballs and the brain were removed. The rest of the rats were given 1 cc. of 1:10,000 solution of thallium acetate with their food.

July 19: One rat died during the night and was thrown out as unfit for histologic material. Two rats showed marked roughening of the fur and seemed too ill for further use in the experiments. Three of the group that had considerable roughening of the fur, but no other toxic symptoms, were given 1 cc. of the 1:10,000 solution.

July 20: Three of the rats began to show ocular symptoms; one had a redness of the eyes with a serous discharge; two others had redness of the eyes and a mucopurulent discharge. The animals were chloroformed, and autopsy materials were preserved. The rats had an average weight of 200 Gm. at the beginning of the experiment; at death they weighed respectively 150, 160 and 180 Gm.; the two remaining rats were allowed to live as they were practically symptom-free.

August 26: Both rats were apparently normal; the experiment was discontinued.

The protocol of one dog, more or less typical of the group of dogs, is as follows:

Jan. 12, 1933: A male dog, weighing 8.6 Kg., was given a subcutaneous injection over the abdomen of 320 mg. of thallium acetate in 1 cc. aqueous solution.

January 13: Some stiffness of the hindlegs developed; the animal could stand and even walk, but did not have ready use of the rear legs.

January 14: Stiffness of the hindlegs persisted; there were frequent loose stools and a suggestion of salivation.

January 16: Weakness and incoordination of the hindlegs were noted; the animal did not seem to hear well. There was profuse lacrimation, and the stools were less frequent and formed.

January 17: Marked weakness and incoordination were noted; the dog sometimes fell over when trying to turn around. The discharge was heavier and more profuse from both eyes and was definitely purulent from the right eye. There were constipation and some nasal discharge, but no drooling of saliva.

January 18: Milk and dog food were eaten in a small quantity, and then vomited. The dog had retained no food for two and a half days. Incoordination was noted in the gait, standing posture and manner of holding the head. The dog fell over easily and could scarcely regain its feet; there was weakness of the back, neck and legs. There were blepharitis, conjunctivitis and episcleritis; the pupils were wide but contracted sluggishly to strong light.

January 19: The dog could not walk without falling, seemingly owing to weakness of the legs, although general instability of the muscles was apparent; congestion of the eyes was more pronounced; the nictitating membrane was inactive; the corneas were somewhat dull; the pupils did not give visible reaction even to a flashlight stimulus, but the continued exposure to bright light caused them to become smaller; the fundi showed hyperemia of the nerve heads, but no swelling; the eyes were enucleated under chloroform. The anesthetic was continued until the animal died. The brain was removed.

Although the rabbits were found to be susceptible to small doses of thallium, it was noted in three specific instances that they seemed capable of recovering completely after severe early symptoms. As soon

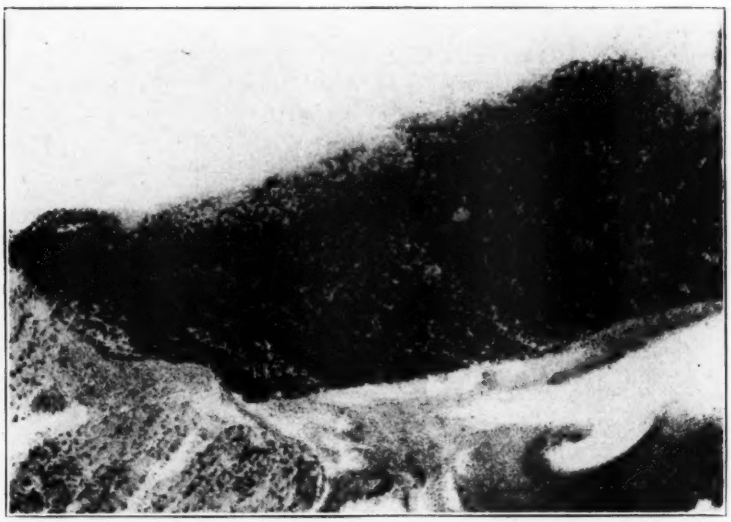

Fig. 7.—Retrobulbar abscess. Low power.

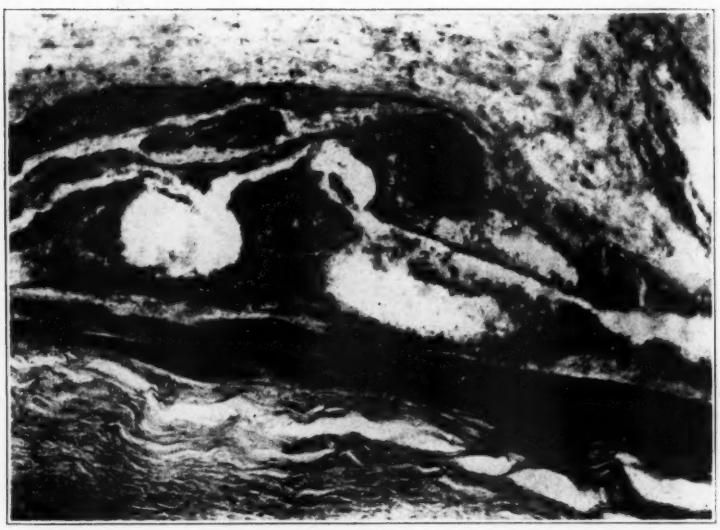

Fig. 8.—Infected thrombus in the wall of a vein in retrobulbar soft tissues. Low power.

as they were apparently overcoming the toxic effects of the initial injection, a second dose was given. It was seldom necessary to resort to any further measures, as death was usually imminent within a few days after the second administration of the drug. In one case, however, it was necessary to give a fourth injection before a fatal intoxication was produced. The protocol of this animal is presented:

Jan. 12, 1933: A female albino rabbit, weighing 2.5 Kg., received an injection into the flank of 20 mg. of thallium acetate in 0.5 cc. aqueous solution.

January 13: No effect was noted.

January 14: No effect was noted.

January 15: The animal seemed entirely normal.

January 19: No effect was noted. Another injection of 30 mg. of thallium acetate was given.

January 21: There was no digestive disturbance or incoordination. The animal ate normally; the eyes were clear.

January 23: There was some redness of the eyelids but no discharge.

January 24: No change was noted.

January 25: Increased redness of the eyelids occurred; there was conjunctival injection but no discharge.

January 26: An injection of 30 mg. of thallium acetate was given.

January 27: There was considerable moisture over the lower jaw as though from drooling of saliva, with some thinning of the hair under the lower jaw. The animal moved about but did not appear to be so well; the eyes were kept partially closed but opened widely when the animal was agitated.

January 28: The rabbit drank water but did not eat; the other symptoms were as noted.

January 30: The animal improved considerably and ate and drank; it moved about more actively; the eyes were only slightly red.

February 2: The rabbit appeared to be overcoming all symptoms; a subcutaneous injection of 50 mg. of thallium acetate was given.

February 3: There was redness of the eyes, with a conjunctival discharge.

February 4: The animal did not eat; the discharge from the eyes was more profuse.

February 6: The condition was essentially the same.

February 7: The lids and conjunctivae were very red; there was a profuse discharge of pus; the corneas were somewhat dull; the pupils dilated and did not contract normally, but became smaller after a time when exposed to a flashlight stimulus; the head was down, with the lower jaw almost touching the floor of the cage; the animal moved when disturbed but was weak.

February 8: The animal was very weak. It was chloroformed, and specimens were obtained.

In general, the autopsies showed no macroscopic pathologic process in the meninges or brain, but there was profuse hemorrhage when the vessels of the posterior orbit were cut during enucleation. For the most part, fixation with formaldehyde was employed. Routine sections were made of the eyeball, optic nerve, optic chiasm, optic tract, midbrain and calcarine fissure. These were stained by the usual hematoxylin and eosin method. While no particular type of lesion was anticipated in

this study, it was considered advisable to resort to special methods of staining in case the pathologic changes were limited to the neural elements. Marchi's and Nissl's methods were applied in these instances.

The histologic changes in the eyeball were: diffuse purulent conjunctivitis, keratitis, scleritis, iritis, cyclitis and retinitis. The lids uniformly exhibited cellular infiltration. In the extra-ocular muscles, diffuse round cell infiltration was noted. The retrobulbar soft tissues were frequently seen to exhibit infected venous thrombi, and this area was also the site of extensive hemorrhage. The optic nerve showed neuritis and perineuritis. Only a few chiasmal sections have been made, and

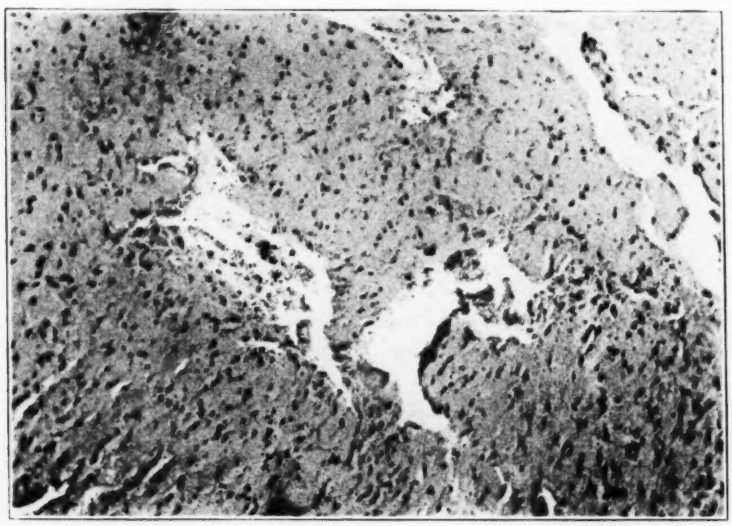

Fig. 9.—Petechial hemorrhage in the calcarine fissure. Low power.

up to the time this report was written the only change of note was hyperemia. In the optic tract there was leukocytic infiltration; the meningeal vessels were engorged with erythrocytes, but occasionally these were displaced by polymorphonuclear leukocytes. The midbrain presented focal gliosis, satellitosis, disintegration of ganglion cells and capillary dilatation. In the calcarine fissure were meningeal hyperemia, satellitosis and petechial hemorrhage.

COMMENT

So far as I have been able to learn, this is the only animal research that has been attempted in order to show specifically what effect thallium produces on the visual apparatus. The much quoted statement that Buschke and his co-workers reported partial atrophy of the optic nerve

was found in the original [6] to consist of a single italicized sentence which announced the fact without explanation. Meyer [7] claimed priority for the first clinical case to be reported with visual reduction due to thallium. This patient, an employee of a chemical plant in which large quantities of thallium were handled, was found to have an immature cataract and a posterior synechia in one eye. The opacity of the lens was thought to be due to thallium, though no statement was made concerning the cause of the posterior synechia. The visual reduction was the same in each eye, and, since there was bilateral pallor of the optic nerve with central scotoma, it is apparent that the essential cause for the failing sight was the involvement of the pathway of the optic nerve. Ginsberg and Buschke,[8] in a report on the cataracts of rats produced by thallium, pointed out that iritis also occurred; in a single case they found cellular infiltration of the ciliary body. They also stated in their communication that the aqueous contained albumin with a fibrinous coagulum. In their studies they found the optic nerve to be normal in appearance. They were of the opinion that the feeding of thallium has an effect on the endocrine-sympathetic system, and among various other manifestations caused the formation of cataract and iritis. Richet [9] produced double keratitis in three dogs into which he injected thallium acetate intraperitoneally. Strange to say, he specifically stated in his report that there was no conjunctival inflammation associated with the keratitis.

The closely scrutinized clinical cases of Mahoney,[10] Stine,[11] Lillie and Parker,[12] Meyer [7] and others presented definite evidence of pathologic change in the pathway of the optic nerve. As Benedict [13] has said, "the toxic effect on vision and the ultimate change in the nerve that may be caused by such substances as alcohol, nicotine, lead, quinine, arsenic and thallium are well known." Generally speaking, the visual decline

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6. Buschke, A.; Lowenstein, L., and Joel, W.: Weitere histologische Befunde bei experimenteller chronischer Thalliumvergiftung, Klin. Wchnschr. **7**:1515, 1928.

7. Meyer, S.: Changes in the Blood as Reflecting Industrial Damage, J. Indust. Hyg. **10**:29, 1928.

8. Ginsberg, S., and Buschke, A.: Ueber die Augenveränderungen bei Ratten nach Thallium Fütterung (Katarakt und Iritis) und ihre Beziehungen zum endokrinen System, Klin. Monatsbl. f. Augenh. **71**:385, 1923.

9. Richet, C.: De la toxicité du thallium, et kératitis, dans l'intoxication chronique par le plomb ou par le thallium, Compt. rend. Soc. de biol. **1**:252, 1899.

10. Mahoney, W.: Retrobulbar Neuritis Due to Thallium Poisoning from Depilatory Cream, J. A. M. A. **98**:618 (Feb. 20) 1932.

11. Stine, G. H.: Optic Neuritis and Optic Atrophy Due to Thallium Poisoning Following Prolonged Use of Koremlu Cream, Am. J. Ophth. **15**:949, 1932.

12. Lillie, W. I., and Parker, H. L.: Retrobulbar Neuritis Due to Thallium Poisoning, J. A. M. A. **98**:1347 (April 16) 1932.

13. Benedict, W. L.: Retrobulbar Neuritis and Disease of the Nasal Accessory Sinuses, Arch. Ophth. **9**:893 (June) 1933.

has been gradual rather than sudden; particularly was this true in the cases in which Koremlu Cream had been used. In other words, the clinical picture was that of chronic intoxication which affected the pathway of the optic nerve insidiously; the symptoms were for the most part those of a bilateral retrobulbar optic neuritis. In Stine's [11] case, as well as in several others, there were pallor of the optic nerve and other evidences of atrophy. Besides the conditions of the optic nerve, other clinical data have been pointed out by various observers. As previously mentioned, Ginsburg and Nixon [1] found ptosis, strabismus and dilated pupils. Rambar [14] observed pupillary widening together with redness and edema of the lids. Kaps [15] noted blepharitis and conjunctivitis. Meyer's [7] observation of cataract and a posterior synechia has already been referred to.

Attention is invited to the fact that in the subjects of the experiments presented in this study all parts of the visual pathways, even including the cortex of the occipital lobe, showed pathologic changes. It is quite possible, then, to explain the visual defects, from a slight blur to complete amaurosis, on the basis of the direct effects or after-effects of thallium intoxication. The pupillary widening with eventual contraction to a strong light stimulus is explainable as follows: There was some conductivity of light impulses because neither the retina nor the optic nerves were atrophic; although there were destructive lesions in the nucleus of the third nerve, they did not invalidate the pupillary control completely, but did permit dilatation; finally, there was an iritis which made the fibers of the sphincter pupillae muscle still more sluggish. This argument must be defended against the objection that in iritis the pupil becomes small instead of large. But it is obvious that the case in point is not typical of those encountered in the practice of the clinician. The pathologic process in the nucleus of the third nerve was sufficient all but to destroy the pupillary control and may be regarded as responsible for an early effect which the iritis could not overcome. Since no posterior synechia was found even histologically, it seems tenable that it is a rare finding; this would support other clinical and experimental studies on that point.

Although the choroid showed marked engorgement of its blood vessels, no cellular infiltration was found. It may be mentioned, however, that the choroid will receive further consideration, as some of the work is being repeated. There was some evidence of pathologic change in every part of the eyeball and its adnexa, the lens alone excepted.

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14. Rambar, C. A.: Acute Thallium Poisoning: Report of Case Due to Accidental Ingestion of Rat Poison Containing Thallium Sulphate, J. A. M. A. **98:** 1372 (April 16) 1932.

15. Kaps, L.: Kriminelle tödliche subakute Thallium Vergiftung, Wien. klin. Wchnschr. **40:**967, 1927.

When Munch, Ginsburg and Nixon [16] stated that "round cell perivascular infiltration was not a part of the microscopic picture," their findings were based on the results of necropsies that were conducted on six cases in human beings. In the experimental studies which form the basis of this paper, round cell perivascular infiltration was not a predominant change, but it was encountered in both the meninges and the eyeball.

The eyes of the rats showed essentially similar changes to those which have been detailed for rabbits and dogs. Although there was but little evidence of ocular disease in these animals while they were alive, the microscopic studies show that every part of the eyeball, exclusive of the lens, presented definite phenomena of the intoxication. In the conjunctiva, cornea and sclera the cellular infiltration was much less marked in the rats; in the iris, ciliary body and retina the changes were also greater in the larger animals; in the optic nerve, its sheaths, the choroid, the retrobulbar connective tissue and muscles, the changes were similar in all cases. The many instances in which massive round cell infiltration was found in the retrobulbar soft tissues was striking.

CONCLUSIONS

1. Thallium acetate is fatal to experimental animals when administered even in small doses.

2. Rodents exhibited greater tolerance to the drug than dogs.

3. Feeding experiments with rats failed to cause cataractous changes that could be detected even histologically.

4. All experimental animals presented evidences of pathologic change in every part of the visual pathway, even including the cortex of the occipital lobe.

5. The lens was the only structure of the eyeball that was not affected by the intoxication.

6. Massive round cell infiltration was frequently encountered in the ciliary body as well as in the retrobulbar connective and muscle tissues.

ABSTRACT OF DISCUSSION

Dr. Edward Jackson, Denver: The investigation by Dr. Swab seems to show that thallium is a general protoplasmic poison. It is capable of producing either acute or chronic poisoning. When Sir William Crookes first saw the characteristic green line in the spectrum he thought that it represented an element like sulphur or selenium, but when it was isolated it proved to be a metal closely resembling lead. Lead poisoning has been known for more than three hundred years, and is the cause of occupational diseases like painters' colic or wrist drop.

Yet only a few years ago, in Australia, a peculiar disease affecting young children was found to be a form of lead poisoning. The lead paint used on the

16. Munch, J. C.; Ginsburg, H. M., and Nixon, C. E.: The 1932 Thallotoxicosis Outbreak in California, J. A. M. A. **100**:1315 (April 29) 1933.

houses disintegrated in strong sunlight, and the dust and scales which were transferred by the child to its mouth slowly accumulated in the child's system. At this meeting lead poisoning from a new source claims attention in another section. Arsenic in wallpaper has been a similar cause of arsenical poisoning. More than twenty years ago it was found that all compounds of thallium were poisonous. The similarity of thallium to lead in its predilection for the nervous system is illustrated in the observation of involvement of the nervous apparatus of vision from the retina to the occipital cortex. Thallium has been made particularly dangerous by its use in widely advertised proprietary preparations, without any intimation that they contain thallium, and without the proper label, "poison."

Dr. George H. Stine, Colorado Springs, Colo.: I shall confine my remarks to a case of thallium poisoning that I saw in 1931 when interest in the subject was just being awakened. A woman, about 47 years of age, had been in the hospital for about three months with peripheral neuritis, which was thought to be infectious in origin. There was neuritis in both legs, with such severe pain that the patient could not stand the weight of covers on her feet. Motor symptoms developed (foot drop), so she could not walk. Thorough physical examination was made; infected teeth and tonsils were removed, and a vaccine of Streptococcus viridans was made and administered without benefit.

In July, the report of Duncan and Campbell appeared, and this led the physician in charge to suspect thallium acetate poisoning; at the same time it was discovered that the patient had been using Koremlu Cream all the time she was in the hospital. That was immediately stopped. She was referred to me because of defective vision in one eye. The eyes were normal externally, but on ophthalmoscopic examination there was found to be a moderate advanced optic neuritis in the left eye and postneuritic atrophy of the optic nerve in the right eye. I followed this patient for six months, and throughout all that time she improved. This is one of the few cases in the literature in which improvement is recorded.

[Slides were shown.]

In the right eye there was some contraction of the form field, with an absolute sector scotoma, typical of optic neuritis, breaking through the nasal periphery. The vision was 3/10 corrected. The left eye showed mild beginning optic neuritis. The vision decreased to 6/10. It is interesting to see in the left eye the enlargement of the blind spot to different-sized test objects, form and color.

This slide shows the fields that were taken a few months later; there was definite improvement in the scotoma, which was surprising to me; it had contracted, and the field for colors had enlarged. On the Lloyd stereocampimeter there was found a definite reduction in the size of the previously enlarged blind spot. There was little change in the size of the scotoma in the right eye. The vision had recovered to 0.9 in the right eye, and to 1.1 in the left eye. I have not seen the patient since that time, but on inquiry it appears that there has been no loss of vision. What the fields would show, I cannot say. The motor symptoms all cleared up, including the high-stepping gait. On the last visit the patient walked into my office unaided, and with a fairly normal gait.

Dr. Arthur Bedell, Albany, N. Y.: By calling attention to the risk following the absorption of thallium, Dr. Swab has aroused interest in an important poison. Fortunately, many communities now prohibit the sale of the most dangerous forms of the drug, thereby reducing the number of lesions of the optic nerve.

Miss T., aged 26, was seen on Dec. 31, 1930, with vision in the right eye of 1/200 and in the left eye of 2/200. She gave a history of having had difficulty with

vision for the past two months, with pains in her legs, knees, wrists and ankles. Serologic examinations gave negative results.

One slide shows the pallor of the disk with slight change in the retinal vessels and the other slide, the large, positive central scotoma. The patient said that she had not taken or used any drugs, and it was only after weeks of questioning that she finally admitted that she had been using a thallium depilatory. She recovered the function of the arms and legs but, unfortunately, the scotoma persists and her vision has not been restored.

DR. CHARLES M. SWAB, Omaha: I want to add that in the protocols in my paper one can readily see that a great many changes take place in the experimental animals besides those which I have mentioned as occurring in the eyes. Dr. Jackson has just pointed out the fact that thallium acetate is a protoplasmic poison.

Concerning the sale of proprietary depilatories that contain thallium acetate, in a copy of the *Congressional Record* of March 1933 it was stated that a congressman from New York was deploring the fact that present legislation had not been able to stop the sale of Koremlu Cream; he also stated that law suits amounting to over two and one half million dollars had been brought against the original manufacturers, who are now bankrupt. He insisted, however, that the product was still being sold everywhere.

FOVEAL PROJECTION DURING DUCTIONS

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Because of the difference in the language or the terminology used by psychologists from that used by ophthalmologists, it is somewhat difficult to express ideas which have the same ultimate meaning to both groups. This difference is primarily due to the diverging purposes of the two branches of science. While ophthalmologists are mostly interested in applying their knowledge to the practical art of healing eyes, the psychologist is determined to examine the behavior of the eyes, to establish data and to build theories, without making any effort to help or heal the eyes under examination. Consequently, when data have been found which are not consistent with past theory and are eventually challenging to methods of practice, it is with considerable reluctance that these findings are circulated in psychologic terms, before some additional or replacing elements have been found to supplant any changes indicated as necessary. And yet there are certain aspects to the present accumulation of data that make it necessary to publish them. It is more in the nature of a questioning or warning than in the nature of criticism that this paper is prepared.

Experiments concerned with movements of the eyes during binocular vision have been carried out by me in Dr. H. M. Langdon's ophthalmic clinic in the Presbyterian Hospital of Philadelphia. They have been particularly directed toward the study of movement during binocular fixation in the artificial conditions best expressed by the term "ductions." It was hoped from this investigation to learn something of that retinal area called the "fovea centralis."

To review briefly the theory of the fovea centralis and the closely allied theory of corresponding retinal points is essential to this discussion. Histologic study of the retina furnishes evidence of a congested area of rodlike cones diametrically opposite the pupil of the eye and containing a central and small depression called the foveola. Cases in which operation has been performed furnish the anatomic evidence of tumor of the brain in certain fairly constant areas of the temporal lobe of the cerebrum which seem to correlate with the patient's reports of scotomatous or blind areas and of various types of hemianopsia.

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In addition to this, there are observations, ancient as medical science, of the coordinated movement of both eyes in following an object of regard from right to left and from left to right. There is even knowledge of certain well defined movement called convergence, when objects are receding or approaching one.

In addition to these facts, one has the evidence of one's own senses when one is able to know the position of an object in space from its visual appearance.

From these meager facts, coupled with various spasmodic investigations, a theory of retinal structure and of ocular behavior has been developed which claims that each retina, through decussations and semidecussations, is connected with some portion of the central nervous system in such a manner that the two refracted images on the retinas, from a single external object, are perceived as though superimposed or fused. A comparison has been drawn, from the knowledge of optics, between the eye and the camera, and the retinal image has been considered as similar to the camera image, and the retina as similar to a photographic plate. How dangerous the comparison can be, if it is carried too far, is understood by all, although it is useful in introducing the study of physiologic optics to younger students.

From this crude analogy, from often unverified observations, from spasmodic knowledge of tumor localization and from the histologic study of dead and artefact retinal tissue and the tract of the second nerve, gross liberty has been taken in developing a theory of binocular fusion and ocular movement. The theory depends primarily on a point of reference called the fovea and on a geometric consideration of the two retinal images as lying at corresponding distances from this fovea. These are the so-called corresponding retinal points. To include a certain degree of inaccuracy, found in even early investigations, the theory has been modified to one of point-to-area correspondence; the two areas overlap or decussate, in some yet unknown manner, on their way to the final brain centers, so that fusion takes place.

It has been my desire to begin a series of investigations which would determine the movement of the eye during binocular vision, so planned that even though one is unable to dissect out the fovea in a living human specimen, one can at least conjecture the accuracy of its position from the behavior of the eye and the perceptual responses.

Convergence and ocular movement have been measured in a manner which, while hardly more accurate than the methods of the past, is at least adequate to show up certain deficiences in the theory. These observations have definitely indicated that both foveae are not always under the images of the object of regard, when this object is fixed by both eyes. Under the various conditions of this investigation the sub-

jects studied have reported binocular vision in conditions when the images were on opposite sides of the two foveae, if the foveae are considered as anatomic points or small areas.

To come to the conclusion that objects are not fused by means of the anatomic corresponding points, nor from their position in respect to an anatomic fovea, a great deal of careful investigation has been carried out. Methods and apparatus, perhaps the greatest task of all scientific endeavor, had to be developed to make these particular investigations. A large and very accurate stereoscope has been constructed with the mirrors so arranged that the subject sees a large black field with his right eye and another similar field with his left eye. The position of rest or the phoric positions of each eye are determined while he is looking into this stereoscope. This is simply a modification of the familiar phoria or muscle test.

In back of the large field of the sterescope are placed two telescopes, so arranged that they are focused on the subject's eyes. When these eyes move, the telescopes are moved by the observer, and the amount of movement is measured on a circular scale. By measuring the positions of the eyes during the phoria test, although one cannot be said to be measuring the position of the fovea, it is possible to make a close estimation, and to determine, from the movement of the eye, change of foveal position.

If identical pictures are placed in each half of the stereoscope, in the positions corresponding to the positions of rest, or phoria, they are fused by the subject. If either of these pictures is moved in or out, the same thing is done as though prisms were placed before the subject's eyes, in the base-out or base-in positions. If the prisms are moved too far from the position of rest, the subject reports diplopia, just as he reports diplopia if too much base-in prism is put before his eye. But if the prisms are moved almost to the point of diplopia, the subjects still report fusion or oneness. Do the subjects overcome this change of object position by moving their eyes to the position where the foveae are beneath the images, by adjusting themselves to a certain amount of muscle strain? They do not. In overcoming what amounts to an average of 10 prism diopters, base-in or base-out, the eyes of the subjects move through angles often less than half this amount, although occasionally they will even move too far. When one considers the position of a central point of the retina, called the fovea, the measurement of ocular movement has indicated that this fovea is, on an average, from 3 to 4 degrees from the ideal position.

Now this disparity or inequality need not be startling, especially if one does not take the theory of the anatomic fovea too literally. Images fused at unequal distances or on opposite sides of the fovea may have

been fused by perception rather than by mechanisms of neural anatomy. This perception may be one of the common artefacts, produced entirely by the intervention of some higher order of neural mechanism which one may term the mind; the objects are seen as one, although one can be sure from measurement that they exist physically as two separate and distinct entities. But what has been done is to remove this faculty of fusion from the powers of the anatomic neural structure.

On considering what has been done to the subjects, it is found that a strain on the external muscles has been produced, a strain which cannot be completely overcome. This is the same as though the subjects had been temporarily changed into patients suffering from a high degree of phoria: exophoria when the objects are moved apart, and esophoria when they are moved closer together. Conversely, it is possible to draw a parallel from their behavior and the behavior of subjects actually suffering from a high degree of phoria who undergo continual strain in overcoming their difficulty during normal vision. But to assume that they overcome this strain completely is dangerous, since such subjects may have almost normal binocular vision, yet may not be turning their eyes in such a manner that anatomic foveae receive the retinal image of the object of regard.

To test this possibility further, certain subjects were required to look successively at two points on a large perpendicular field, at a distance of half a meter, and each point was placed equally distant from a center line. They did not look into mirrors, but used their naked eyes, except when their glasses were available. When they looked at these two points, they should have used the same amount of convergence. And if they did not, one can be certain that at some time in the test the fovea of either eye was not directly below the image of the object of regard. In many cases there was a difference of as much as 4 or 5 degrees between the two fixations, and yet these fixations should have been identical. Hence one can conclude that even in normal vision, the two foveae are not under the two retinal images, although the subject reported single binocular vision. Needless to say, care was taken to prevent either eye from suspending without the experimenter's knowledge.

A few persons with borderline amblyopia, and one with complete blindness in one eye, when undergoing this test, moved their eyes in a manner indicating as accurate mechanical fixation as that evidenced by normal patients.

There are certain clinical tests common in practice that are dependent to a great extent on the assumptions of the theory of retinal correspondence and foveal fixation. When the phoria of a patient is measured, whether it is by a Maddox rod or by any other means, one cannot be sure that one has measured the positions of the subject's eyes, nor

even if one has measured the positions of his eyes can one assume, a priori, that one has found the reason for his discomfort. One cannot assume that this phoric deviation is always, or even occasionally, overcome in the patient's binocular fixations.

When the ductions of the patient are measured, it has been claimed that one is measuring the amount of independent movement of which the eyes are capable. But this has not been done; a measurement of the movement has been obtained, but it is subject to the amount of disparity or retinal difference which the patient will tolerate. When what has been called relative convergence and also what has been called accommodative convergence are measured, the amount of movement which has occurred in fact has not been measured accurately. This does not mean that these tests are useless, but that their results must be regarded with question, as indicative of what has happened, but not as a measure of the real fact.

It has been my purpose in this paper not to disrupt and vilify the theory on which so much practical ophthalmology is based, but rather to show how this theory is not wholly accurate, and how these tests are not entirely truthful. Since no substitutes are offered at present, one can at least regard the findings of the phoria tests and the duction tests with considerable care, understanding that their value lies, not in their accuracy, but in their interpretation.

ESSENTIAL (PROGRESSIVE) ATROPHY OF THE IRIS

REPORT OF A CASE

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Atrophy of the iris is seen in a variety of conditions, and Duane, in his translation of Fuchs'[1] "Text Book of Ophthalmology," states that it may supervene as the result of (1) long-continued or recurring inflammation, (2) increase of tension involving the blood vessels at the root of the iris, (3) traction on the iris or iridodialysis, (4) too thorough absorption of swelling lenticular material or (5) advanced age or without recognizable cause.

Essential atrophy of the iris—the atrophy without recognizable cause—is not often reported, and knowledge of it is therefore imperfect. The atrophy is progressive, so that congenital anomalies, such as aniridia or colobomas, can be easily ruled out, and little is known concerning its primary cause.

The following case has been seen at intervals for the past six years, and on three occasions sketches were made which show the progress of the atrophy which is characteristic of the disease.

REPORT OF CASE

Miss A. K., aged 49, was seen in 1927, when she came for examination and advice because of trouble with her right eye. For about a year vision had been failing, and more recently she had noticed that the eye was not normal in appearance and that the pupil was drawn over to one side. She knew of no cause for her trouble; at no time had the eye been inflamed or painful, and there had been no injury to it.

Examination showed that vision in the right eye was 6/7.5+ and in the left eye 6/5 (partial). The right eye was perfectly quiet and presented the appearance seen in *A*. The iris was light bluish green and had a rather washed-out appearance, although the delicate markings seen in the normal iris were visible. The pupil was intact but somewhat egg-shaped and was drawn well over toward the temporal side. Adjoining the limbus above were three gaps, which extended completely through the iris and through which the fundus could be seen. About the margins of the pupil and the holes in the iris there was marked ectropion of uveal pigment. The pupillary reactions were present, and tension to digital pressure was normal. The fundus showed no gross lesions.

Refraction was carried out, and a +50 sphere ⊃ —1.25 cylinder, axis 60 was prescribed for the right eye, with which vision was 6/5. A —.50 sphere, axis 105

1. Fuchs, E.: Text Book of Ophthalmology, ed. 6, Philadelphia, J. B. Lippincott Company, 1923, p. 410.

was prescribed for the left eye, with which vision was 6/5. For near vision she needed an addition of a +1.25 cylinder, with which she read Jaeger's test type number 1 easily.

She was next seen in 1930, when the right eye presented the appearance seen in *B*. The pupil was now vertically oval and had been drawn far to the temporal side, so that its outer border was hidden behind the limbus. The two smaller openings along the upper limbus had coalesced to become one large gap, while the largest hole had increased in size and extended down the mesial side as far as 3:30 o'clock.

At this visit she stated that recently she had had some attacks of moderate pain, accompanied by some inflammation of the eye, which had lasted a day or two, but when she was seen the eye was perfectly quiet and comfortable. Examination of the fundus gave negative results, and tension with the Schiötz tonometer was 22. The visual fields were taken at this visit, but revealed no abnormalities.

She was seen several times during the next three years, and her last visit to the office was in July 1933. She continued to have attacks of slight pain and redness of the eye at times, but did not think them of enough importance to come for observation. At this visit the eye was quiet and comfortable, and the iris now had the appearance seen in *C*. The pupil had become narrower and longer, and ectropion of the pigmentary layer was conspicuous along its visible border

Appearance of the right eye of the patient with essential atrophy of the iris. *A* shows the appearance of the eye at the first examination, *B* the appearance three years later and *C* the appearance three years after that in *B*.

and about the dehiscences in the iris. Any pupillary reaction to light was doubtful. Tension was 24 (Schiötz).

Ophthalmoscopic examination showed the fundus to be still essentially normal in appearance, and there was no pathologic cupping of the disk. Vision continued to be good and was 6/5—2 with a —.25 ⌒ 1.00 cylinder, axis 15. The left eye had never troubled the patient; it was of normal appearance, and vision with correction was 6/5. The visual fields were taken again, but showed little deviation from the normal.

Examination with the slit lamp gave no additional information. The cornea appeared to be normal, and there were no deposits on its posterior surface. No cells were seen in the aqueous, and there were no deposits on the anterior capsule of the lens. Several minute atrophic gaps in the tissue of the iris, which had not been seen before, were noted, but on the whole nothing was discovered which had not been seen with the loupe.

At this time the patient was advised to have a general examination, as it was known that in some reported cases of this condition there had been latent tuberculosis or some other disease which might have had some bearing on the changes in the iris. Her general health was good, and physical examination disclosed nothing of importance. Wassermann and urinary tests gave negative results, and nothing was found which might be considered to be the cause of the condition in her right eye.

COMMENT

It has been suggested that some constitutional fault, such as derangement of the secretion of the ductless glands, might be the etiologic factor in this unusual disease. De Schweinitz' [2] patient had latent tuberculosis together with gastro-intestinal intoxication, and Lane's [3] patient was almost certainly tuberculous.

General examination, however, has usually given negative results, and it would not seem that the cause could be a constitutional one, for in all the reported cases only one eye was attacked, the other remaining perfectly normal. Feingold [4] believed that in his case there may have been congenital vascular disturbances near the lesser vascular circle which could have induced the changes in the iris, and Lane thought it probable that the causal factor was a disturbance of circulation due to sclerosis of the vessels of the iris. Jeancon [5] favors the idea of Kricker, who assumed that the same biologic process which was responsible for the absorption of the capsular and pupillary membranes in uterine life continued to be effective in after life, attacking the tissue of the iris and causing it to disappear. But if this is the case, it is hard to understand why the iris appears to be normal for so many years and then the atrophic changes slowly set in. Whatever the etiology may be, the most important facts are insufficiently known, and as yet there has been no positive explanation for the clinical entity of this condition.

In nearly all the reported cases, increased intra-ocular tension has sooner or later been one of the conspicuous symptoms, and in the few cases in which microscopic examination has been possible, the eyes have been removed because of absolute glaucoma. Rochat and Mulder [6] found that in their case the root of the iris was soldered to the cornea and that, while there were undoubtedly a few signs of a slight recent inflammation, it was doubtful whether they had any relation to the atrophy of the iris, as these inflammatory signs may be found in the same degree in every advanced case of glaucoma. Feingold and others reported essentially the same changes in the eyes which they examined and in addition noted deep cupping of the optic disks. Wood's [7] patient had fibrinoplastic iridocyclitis, but it is doubtful whether it should be classed as a typical example of essential atrophy, as the theory of underlying low grade uveitis is no longer accepted as a causal factor.

Waite's [8] patient was subjected to repeated and searching examinations with the slit lamp, but except for some fine points of pigment on

2. de Schweinitz, G. E.: Tr. Am. Ophth. Soc. **14**:250, 1915.
3. Lane, L. A.: Ophth. Rec. **26**:258, 1917.
4. Feingold, M.: Am. J. Ophth. **1**:1, 1918.
5. Jeancon, E.: Am. J. Ophth. **16**:813 (Sept.) 1933.
6. Rochat, G. F., and Mulder, W.: Brit. J. Ophth. **8**:362, 1924.
7. Wood, R.: Ophthalmoscope **8**:858, 1910.
8. Waite, J. H.: Am. J. Ophth. **11**:187, 1928.

the posterior surface of the cornea, which simulated Krukenberg's spindle, these examinations always gave negative results.

Usually, the first sign of progressive essential atrophy has been marked displacement of the pupil. The pupil is drawn far to one side, but remains intact, and in the early cases the reflexes are retained. The displacement of the pupil might be explained by assuming primary atrophy in one part of the iris, in which case the pupil would be drawn to the opposite side as the result of disturbed equilibrium. Rochat and Mulder, however, believe that the pupil is pulled over to one side by adhesion of the root of the iris to the cornea at a circumscribed spot and that the gaps in the iris are tears caused by tension on the tissue of the iris.

Microscopic examination has given no clue as to the cause of the obliteration of the angle of the anterior chamber or as to which is the primary process—the atrophy or the glaucoma. Bentzen and Leber [9] were of the opinion that the atrophy is the result of slow-running glaucoma, but most authors have thought that at first there is no increase of intra-ocular tension, although they offer no basis of proof for such an assumption except that clinical examination in early cases has shown that, even with marked atrophy, glaucoma could not be detected and that the eyes were functionally normal.

In the case of Miss A. K. the intra-ocular tension was never found to be elevated, and there was no pathologic cupping of the disk. However, it is not unlikely that the attacks of dull pain and slight congestion of the eye which she had occasionally experienced were transient attacks of glaucoma and that in the future the tension may be more constantly elevated.

When so little is known concerning the etiology of the disease, it is not surprising that treatment has usually been unsatisfactory. As yet, nothing has been found which will halt the atrophy, and, while treatment of the increased tension by miotics or operation has been somewhat successful, in the long run the eyes have usually been lost because of absolute glaucoma. However, the patient may be assured that the other eye is reasonably safe from the disease, for in all the reported cases only one eye has been involved.

CONCLUSIONS

Could a microscopic examination be made at the beginning of the disease, the cause of the atrophy and glaucoma might be discovered, but as there is little chance that such an examination will be possible it is probable that the etiologic factors will not be elucidated in the near future.

9. Bentzen, C. F., and Leber, T.: Arch. f. Ophth. **41**:229, 1895.

SOME FACTORS CONCERNED IN THE CORRECTION OF APHAKIA

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The aphakic eye represents an optical system of the simplest form, that is, a single curved surface, the cornea, separating air from the aqueous and the vitreous, both of which may be regarded as a single medium, since they have nearly the same index of refraction. It has the same length as the normal eye, but without the crystalline lens it has lost a considerable amount of dioptric power and, therefore, represents a high type of curvature hyperopia. It is devoid of accommodation.

In the exact schematic eye of Gullstrand the crystalline lens system at rest is given a power of 19.11 diopters, reduced for air. This is lower than the power assumed for the lens by most other authorities. The reduced power of Helmholtz' lens for air is about 26.39 diopters and of Tscherning's lens, 21.39 diopters.

While the actual power of Gullstrand's crystalline lens is 19.11 diopters, because of its distance behind the cornea, it really adds only about 15.6 diopters to the refractive power of the eye as a whole. If Gullstrand's lens were situated 1 mm. nearer the cornea than he placed it in his schematic eye, it would add 0.65 diopter more to the total refracting power of the eye; 2 mm. nearer would add 1.3 diopters, and 3 mm., 1.88 diopters—a difference that would be corrected by a properly placed concave spectacle lens of less than 2 diopters. For this reason, added to the change in positions of the principal points, an increase of 13.95 diopters in the power of the crystalline lens during maximum accommodation adds only 11.93 diopters to the total refractive power of Gullstrand's schematic eye.

On removal of the lens the principal point refraction of this aphakic eye is about 12.6 diopters of curvature hyperopia, and, if the second principal point of the correcting glass is placed 14.5 mm. in front of the cornea, the required corrective power would be + 10.74 diopters.

However, an axial myopic eye which is corrected by a — 10.74 diopter lens will not be emmetropic after removal of its crystalline lens. Based on the same constants and disregarding the aberration, this myopic eye would be about 27.5 mm. in length, 3.1 mm. longer than the normal, previously emmetropic, aphakic eye. Unless there is definite

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knowledge to the contrary, the axial length of the globe must be taken into consideration in making any calculation for ametropia. Therefore, an eye corrected by a — 10.74 diopter lens placed 14.5 mm. in front of the cornea would, after becoming aphakic, require a convex lens of nearly 5 diopters.

The same reasoning must be applied to hyperopia. For example, an aphakic eye, which previous to removal of its crystalline lens had been corrected with a + 5 diopter lens, will have a principle point hyperopia of 17 diopters and be corrected by a + 13.66 diopter lens, placed 14.5 mm. in front of the cornea.

The schematic aphakic eye of Gullstrand has a posterior focal length of 31.031 mm., and in order for an eye to be emmetropic after removal of the crystalline lens it would have to be actually this size. Theoretically, an eye which is corrected by a — 16.7 diopter glass will be 31.031 mm. in length and emmetropic after removal of its crystalline lens; but practically, allowing for aberration, it will have been corrected by a concave lens of about 18 diopters. Probably the ideal aphakic eye would have a retained myopia of about 3 diopters. It would be able to see clearly for near vision and have fairly useful vision at ordinary distances without a correction. Theoretically, such eyes would have required — 22.68 diopter lenses at 14.5 mm. distance before operation; but practically, allowing for the aberration, about — 24 diopter lenses.

A rough estimation of the correction for the aphakic eye can be made by adding + 10 diopters to one half the power of the glass necessary to neutralize a previously existing ametropia. For example, an eye which was previously corrected by — 10.75 sph. will require + 10 sph. — 5.37 sph. = + 4.62; one with 5 diopters of hyperopia, + 10 sph. + 2.50 sph. = + 12.50; one with a myopia of 18 diopters, + 10 sph. — 9 sph. = + 1, and a myopia of 24 diopters, + 10 sph. — 12 sph. = — 2 after removal of the crystalline lens.

Nothing of what has just been said, however, can be applied to aphakia in very young children. It is well known that the globe of an emmetropic infant is so short that if the complete optical system had the same power as that of the adult eye it would be axially hyperopic 18 or 20 diopters. The excess power must exist in the crystalline lens, since the radius of curvature of the cornea of an infant hardly differs from that of an adult. Therefore, the dioptric power of the crystalline lens will vary with the age of the patient from infancy to adolescence. It is on the average age of the latter that the constants of Gullstrand's and nearly every other schematic eye are based.

The schematic aphakic eye of Gullstrand has a power of 43.05 diopters. Its anterior principal focal length is 23.227 mm., while that of the lens-containing eye is 17.055 mm. The linear size of the image

for the schematic aphakic eye, therefore, will be to the size of the image in the schematic lens-containing eye in the proportion of 23.227: 17.055 if the correcting glass is placed at the anterior principal focus—roughly, 23: 17, or about 1.35 times larger in the aphakic than in the normal emmetropic eye. In practice, the lens is always closer to the eye than this, and the closer position tends to diminish the size of the image; but even so, the retinal image is considerably larger in the aphakic than in the lens-containing eye. To the enlargement of the image is due the remarkable acuteness of vision sometimes obtained in aphakia. This is especially true of eyes which were previously myopic.

The least variation in the position of the ordinarily strong glass before an aphakic eye produces a noticeable change in its action: on the size of the retinal image, with regard to its refractive power and in its prismatic effect.

The position of a lens is determined by the positions of its principal points, and these depend on the shape and power of the lens. This is why it so frequently occurs that unless the finished spectacles are of corresponding shape and in the same position before the eyes as were the trial lenses, they will not represent the precise corrective value which the ophthalmologist obtained. If, in the instance of previous emmetropia in which the aphakia was corrected by + 10.75 sph. at 14.5 mm. in front of the eye, the lens were placed 3 mm. closer, there would be a difference of 1.16 diopters; the lens would have to be that much stronger. If it were moved 3 mm. farther away it will have to be 0.35 diopter weaker. The advantages of any change in position should be utilized, and it is a good rule when the patient returns with his glasses (in any case of high ametropia) to push them closer or pull them farther away, and if the vision is improved, have them readjusted by the optician. It is often forgotten that small differences in dioptric power are more noticeable in an aphakic eye, with absolutely no accommodation, than in a normal eye. Another reason for trying the effect of slightly changing the distance whenever the finished spectacles are of high power is that very small variations often can be made better in this way than by manifest refraction because of the lack of small divisions in the higher powers of the ordinary trial case lenses—a particular disadvantage in the strong trial cylinders. Extreme care must be exercised with trial lenses when it is necessary to use two cylinders to make up a certain power. It should be remembered, too, that with a hyperopic correcting glass the retinal image is made larger as the distance from the eye to the glass is increased, and smaller when decreased, and that this effect is greater in the higher powers. Thus, it is obviously important that the glasses be exactly the same distance from both eyes and that they be kept that way.

In these strong lenses the slightest tilt gives a cylindric effect which is easily produced in the finished glasses. Because of this, since in aphakia the astigmatism is usually against the rule and also because the astigmatism varies for some time after operation, it is good practice to give as little cylinder as possible, or even slightly undercorrect deliberately, and then bring out the full correction by tilting the finished glasses. In very low astigmatic errors the entire cylinder may be introduced in this way. It requires a remarkably small amount of tilting of a + 10 diopter lens to produce a 0.50 diopter cylinder. A disturbing cylindric effect also will be given when, with properly adjusted glasses for distance, the eyes are turned down and the visual lines strike the glasses obliquely for reading. The same glasses, if adjusted for near vision, will give a cylindric effect when the patient looks straight ahead.

Many ophthalmologists design their cataract glasses so that they duplicate as nearly as possible the equal-sided biconvex forms with which most trial cases are equipped. This is justifiable to the extent that the final correction corresponds very nearly to that obtained with the trial lenses; but a biconvex shape is certainly not the best, and good form in cataract lenses is even more to be desired than in the weaker powers. The field of view with strong convex glasses is restricted even when the glasses are most scientifically designed. This, added to an entirely new kind of vision, is most disturbing to the patient who has recently become aphakic. He is not pleased with the final result even with full 6/6 vision and seems ungrateful. His field is so restricted that he sees distinctly only through the center of the glass and, since the vision here is so good, he naturally thinks that there is only some little thing that need be done to extend it a bit. That this is true is borne out when the patient with aphakia in one eye, corrected to 6/6, prefers vision of only 6/12 or even 6/15 with his lens-containing eye.

The coflexure of a convex lens of high power is an extremely important consideration. A good model is a + 14 spherical front. Moderate variations from this are negligible for practical purposes. The positions of the principle points of this shape, however, are different from those of the double convex trial lens, and its corresponding back focal power must be carefully computed. But if the trial lenses were planoconvex, as they should be, no calculation would be necessary because the difference then would be negligible, especially if the distance from the eye to the front of the lens were used (as advocated by Dr. Jackson) instead of the distance from the eye to the back surface. Where there is astigmatism, a convex sphere combined with a concave cylinder is not only economical, but is of as good a shape as any for practical purposes. A good method for finding this is as follows: Proceed with the manifest refraction in the ordinary way with convex

spheres and cylinders, until the proper sphere and cylinder have been found, then replace the ++ combination with a +— spherocylindric combination, the cylinder behind, toward the patient. This will make a notable difference in the power of both the sphere and the cylinder, which must be ascertained by small additions and subtractions. For example, it is found that the correction—cylinder in front as usual—was + 10 sph. 3 cyl., axis 180. The lenses are then taken out of the trial frame and replaced with a — 3 cylinder, carefully set at 90 degrees, with its concave side toward the eye, and combined with a 13 diopter planoconvex sphere in front with its curved surface forward. These lenses, as close together as possible in the trial frame, are carefully adjusted with regard to the distance from the eye. Now whatever refinements are necessary can be made. This combination will have nearly the form of the finished spectacle lens. Finally, if, say + 12.75 sph. — 3.25 cyl., axis 90 is found to give the best result and is so written in the prescription, the optician must be instructed to "grind as written." It is always good to have the same shape, as nearly as possible, for the two eyes. The fused bifocal lens would be the only type possible with this form, since the segment must be placed on the spherical, front surface; but if one piece bifocal lenses are preferred, the difference will be negligible if the cylinder is incorporated in the front and the back surface is given a — 2 or 3 sphere. This lens has the advantage over the fused bifocal lens in that the reading portion is of better form for near vision. If the one piece bifocal lens is desired, it will be more conventional if the spherocylindric combination is transposed again into the simpler form and written ++, but the method of procedure should be the same as was just described.

The prismatic effect of decentration of cataract lenses need hardly be stressed. When, with a displacement of only 1 mm., a prism of about 1 diopter is produced, it is extremely important that the pole of each lens be made to coincide with the visual line of the eye and not with the center of the pupil. It is too often forgotten that the visual line does not usually pass through the center of the pupil, even in normal eyes, and that this is especially true in cases of irregular, displaced or mutilated pupils such as might be found after cataract operation. Changing the size or position of the pupil cannot change the direction of the visual line. In extreme cases it may not pass through the pupil at all. For this reason, too, the glasses must be kept straight.

Careful attention must also be given to the plane of the lenses with respect to the visual lines, because an obliquity produces not only a cylinder but also a prism. A moving eye is bound to look obliquely through a fixed spectacle glass, and there will be not only the cylindric effect and the apparent displacement of objects, but also the chromatic,

spheric, astigmatic and other aberrations to be expected when looking through the periphery of a strong glass. All these irremediable defects must be explained to the patient.

After iridectomy, the greatly enlarged pupil allows an amount of light to enter the eye which is more than that to which the patient is accustomed. The result is an annoying glare which sometimes causes an erythropia or red vision after fatigue. Cyanopia, or blue vision, may occur immediately after removal of a cataractous lens. Erythropia and cyanopia, especially the latter, are temporary phenomena. For some time after cataract operation, therefore, persons with aphakia must be given protection against excessive light, that is, dark glasses should be ordered; but these need be worn only when the light is excessive and must be sufficiently dark to give relief. Unless the ophthalmologist has definite knowledge on which to base his judgment in choosing a certain tint, the ordinary no. 3 London smoke glass is as good, if not better, for the purpose than many of the widely advertised miracle glasses which, in the lighter shades, offer little more protection against real glare than ordinary window glass.

The proper management of aphakia is an art depending on a wide clinical experience and a knowledge of basic scientific facts, only some of which can be discussed in a paper of this scope. The person who has recently become aphakic is given an entirely new kind of vision, not that which he expected after removal of the cataracts. Many new and disturbing factors are introduced into the visual act, and he must unlearn the habits and experiences of a lifetime.

Landolt probably expressed the sentiment of every ophthalmologist when he said:

> My satisfaction is always mingled with great apprehension when I see come back to me a fine black pupil which I have delivered of its thick veil; the cataract, removed from the eye, too often is changed into a torrent of complaints against the operator. And we much oftener see a look of gratitude in the empty orbit of him who has suffered an enucleation, than in the quondam cataractous eye, to which we have restored its sight. Enucleation simplifies so many things. Aphakic vision is so complicated.

ABSTRACT OF DISCUSSION

Dr. Derrick T. Vail Jr., Cincinnati: The subject of the correction of aphakia is one which has suffered ridiculous neglect in ophthalmic literature. On the other hand, there is a plethora of articles on the art of cataract extraction, and it appears by this contrast that ophthalmologists are more interested in the means than in the end. This is a curious indifference, because one's reputation as a successful surgeon depend on the patient's visual acuity. The providing of an artificial part to a person deprived of a natural one is always difficult.

This essay, therefore, delivered by so eminent an authority on ophthalmic optics, is timely, practical and filled with valuable advice based on knowledge of wide experience. It must be carefully studied by all ophthalmic surgeons.

Most ophthalmologists will not agree, however, with the note of pessimism which Dr. Cowan conveys by Landolt's quotation. Many have been the completely satisfied patients whose blindness has been relieved and who have expressed joy and gratitude. One can be very certain that Dr. Cowan is not advocating enucleation as a cure for cataract, and I am positive that he receives at least one card of blessing at Christmas from some aphakic patient.

The fitting of a proper lens to an aphakic eye is not only an art, but a science. The physician must supply the art, and the well trained and competent dispensing optician must provide, of necessity, much of the science, as will be shown. It calls for cooperation and understanding between the refractionist and the optician. All too frequently the ophthalmologist is to blame, because he has not followed the rules laid down by Dr. Cowan. The patient, however, condemns the optician, comparing in his mind the trial frame vision with the finished product.

The size of the retinal image in the schematic aphakic eye of Gullstrand is enlarged over the normal emmetropic eye, as Dr. Cowan has mentioned. At 23.2 mm. from the cornea it is 1.36 times as large; at 13 mm., which is about the average, it is 1.23 times as large, and at 6 mm. it is 1.18 times as large. This is about the closest one can fit a cataract lens. At this point the lashes have to be trimmed, and fogging, due to perspiration, has to be anticipated by a thin layer of oil. It is, therefore, practically impossible to correct the aphakic eye to balance with its normal fellow. I understand that contact cataract lenses are being tried out to overcome this difficulty.

The position of the lens in front of the eye is of paramount importance, in regard to the position not only in the trial frame, but also in the finished spectacle. Not only does the size of the retinal image increase the farther away the lens is from the eye, but the refractive power increases as well. The ophthalmologist must, therefore, take every precaution to set the trial lenses as close to the cornea as possible, and take care that the patient is looking through the center, since a slight deviation brings into play the oblique pencils of astigmatism. Unless detected, this will lead to an error in the finished product. The advantages of fitting the lens as closely to the cornea as possible are: 1. The retinal image approaches more nearly the normal. 2. The lens can be less thick and heavy. 3. It is not so apt to slip down, because its weight hangs from the bridge of the nose instead of forward and down.

It occasionally happens that one cannot fit the trial frame as closely to the cornea as one could wish, because of overhanging brows, deep-set eyes or prominent nasal bridge. In all cases, but especially here, the distance between the anterior surface of the cornea to the posterior surface of the lens, or vertex distance, must be accurately measured. The patient's frame can be fitted closer to the eye than can the trial frame, and the correction value must be obtained from tables, or by the refractometer, to make the lens efficient. A rough rule which is fairly satisfactory is to add a $+0.25$ sphere to a lens of $+11$ and a $+0.5$ sphere to a lens of $+13$ or more.

The position of the various components in the trial frame need to be emphasized. One will obtain a different effect, as Dr. Cowan has hinted, by placing the cylinder behind the sphere, or, as so frequently happens, by placing the cylinder on top of the sphere and then piling on top of that small spheres, or another cylinder. The average trial case lenses above 10 diopters are in 1 diopter units, which leads to the banking of units between. Most all ophthalmologists are at fault in this. Various optical houses now supply trial aphakic lenses in smaller units combined with various cylinders. These should prove to be of great value.

In writing the prescription, one should be fair to the dispensing optician. Assuming that one has a good one at hand, a certain amount of leeway can be given him. It is necessary for him to know the vertex distance, that is, the measurement from the cornea to the posterior surface of the lens, the order in which the lenses were placed in the trial frame and the visual result. Unless he is given this information, I believe that to protect his own interests and reputation he should place the prescription lenses in his own trial frame, find out which position gives the patient the best vision, measure this distance and either increase or decrease the sphere as may be necessary in the final frame.

After the prescription has been filled, the patient must return for the surgeon to check the visual result. Dr. Cowan has discussed this point adequately. I might add that one can hold a plus or minus 0.25 sphere in front of the lens and if there is an improvement, request the optician to resurface the lens accordingly.

Now, regarding the difficult problem of the field of view or vista which the patient may get with various cataract lenses. Theoretically, Dr. Cowan is correct in his advocacy of a corrected curve lens. Henker (Introduction to the Theory of Spectacles, Jena, Jena School of Optics, 1924, p. 158) stated that "equal sided cataract lenses exhibit greater astigmatic defects than any other type of lenses. They have the most restricted vista and accordingly are to be eschewed under all circumstances." He supported this statement with ample mathematical proof. The most perfect lens is the Katral or Gullstrand's aspherical cataract lens, prohibitive in price. I have seen only one of these lenses, and it looked like the bull's eye of a large flashlight. Corrected curve spherical cataract glasses are unsightly and heavy, especially in these days when people demand large lenses cut in fancy shapes. True, there is a gain in the vista of from 25 degrees to 40 degrees, or slightly more, by using Tscherning curves, although one cannot achieve point focal vision; but there is slightly more aberration, and it is not always possible to grind a + 14 front lens free of grinding waves. A bad 14 lens makes all advantage disappear. In addition, these lenses are much more expensive. I venture to guess that fully 80 per cent of my patients with cataract are wearing biconvex lenses ground with a 1 mm. finished strap, with much satisfaction and few complaints. They soon become accustomed to the limited vista. Several patients wearing the corrected curve lenses have turned to the equal-sided lens, because they were dissatisfied with the appearance and weight of their former lenses.

Nor can I agree with Dr. Cowan regarding the matter of tint. A 0.3 London smoke glass made up in a thick, heavy cataract glass is too dark, especially in the center. It is necessary, of course, to cut down the glare, but a Crookes "A" lens has been satisfactory in my experience.

The question of a bifocal cataract lens adds to the difficulties. The prismatic effect can be overcome by suitable tilting. The latest types of cataract lenticular bifocal lenses, utilizing a barium segment, have been very satisfactory, and I do not as a rule prescribe bifocal lenses unless the patient can afford this type of lens.

Finally, if the fitting of one aphakic eye is complicated, that of two is not twice but ten times as complicated. In addition to all of the foregoing factors, muscular anomalies frequently enter into the picture. Time does not permit discussing this. It is sufficient to say that a vertical phoria should be corrected fully, whereas a horizontal one generally takes care of itself. It also happens that one eye may present a much greater astigmatism than the other, which is another straw to the fuel. In spite of these difficulties, an analysis of ninety-six of my patients with bilateral aphakia reveals all but two happy and satisfied. The crowning joy to an ophthalmic surgeon is a patient with bilateral aphakia

wearing bifocal lenses and going about his business with content and gratitude in the recovery of his sight.

Dr. Frederick H. Verhoeff, Boston: I thoroughly agree with everything Dr. Cowan said, and for many years I have carried out the practice he speaks of, that of having the patient come back and then experimenting with the glasses he is wearing. There are two practical points, however, that have not been brought out. I have found that when in the trial frame the best planoconvex sphere is somewhere around 10 or 13 diopters, and I add a + 0.50 to it in the prescription, when the patient comes back his glasses are generally as nearly correct as one can get them. One can make any necessary correction by a change in the distance of the glass from the eye.

Another point to bear in mind is that almost invariably there is a change in refraction within a comparatively short time, anyway in three of four months, and one has to change the glasses, so it is not important to get the first glasses perfectly correct. When the patient returns he is tested with his glasses on as suggested by Dr. Cowan.

Another practical point that I should like to bring out is in regard to Katral lenses and other special glasses. I have found that while they do give a better field, they do not often give as good central vision as ordinary lenses. I remember only one patient who had as good central vision with a Katral lens as with what is called a flat lens. I think that a patient would rather have good central vision than improved peripheral vision. With a flat lens the patient must turn his head to see distinctly on each side. This often causes great difficulty at first, but all patients seem to get used to it. As a matter of fact, that is what every one does anyway, for one does not see very distinctly unless one turns one's head.

Dr. Alfred Cowan, Philadelphia: Much more could have been said in the paper, of course, and I should like to thank the discussers for the points they brought out. I am sorry that Dr. Vail has disagreed with so many of my statements.

As far as the lenses being close to the eye is concerned, there is a certain disadvantage in that the closer the lens is the smaller the retinal image will be, and sometimes it is good to make the image large when the vision is not quite so high. Again, a convex lens is necessarily stronger, the closer it is to the eye.

I do not think that one should leave so much to the optician. It is not right to let him set up the prescription lenses in a trial frame and try them out. The ophthalmologist should be competent to do those things. It should be left to the optician to decide the size and shape of the glass, the style of frame and such matters. I do not think that he should be allowed to do any refracting or to verify a prescription.

The + 14 diopter front curve, the lens I mentioned, is cheaper than the double convex lens unless there is no cylinder. To make a spherocylindric cataract lens of double convex shape, one or other surface must be toric. For example, a + 10 sph. with a + 2 cyl. would have a + 5 sph. combined with + 2 cyl. on one side and + 5 sph. on the other. That is an expensive glass. A + 14 diopter front curve with a —2 or 3 diopter back curve is cheaper and optically better.

Bending the lens makes little difference in the weight, unless the difference in power is taken into consideration.

There is one other thing I wanted to say concerning Dr. Verhoeff's statement. In certain of these point focal lenses—lenses in which an attempt is made to correct the astigmatism of oblique pencils—the central power is sacrificed. It is either added to, or taken away from. What Dr. Verhoeff says is true, and it has been mentioned in several articles that I have written.

Clinical Notes

A NEW USE FOR THE ELLIOT TREPHINE HANDLE

JULIAN F. CHISHOLM JR., M.D., SAVANNAH, GA.

I tried for some time to obtain a suitable handle for a dental bur, as I have found that this instrument best removes rust stains in the cornea.

I was able to locate but one, which is manufactured according to specifications of Dr. Cross of the Graduate School of Medicine, University of Pennsylvania. The price, I believe, is $6.50. I was rather loath to pay so much for so simple a thing. I inquired at several dental supply houses but was unable to get a handle that was suitable for use in ophthalmologic work.

I want to call to the attention of ophthalmologists that the handle of an Elliot trephine makes, in my opinion, about as ideal a handle for a dental bur as one can obtain.

It is to be hoped that the use of a dental bur to remove rust stains will be adopted more widely by ophthalmic surgeons, especially those engaged in industrial work. I find that the complete removal of these stains not only speeds up recovery but prevents many mild cases of iritis and eliminates the necessity for curettings at a later visit.

I am writing this in the hope that the men who already own an Elliot trephine will approve of this additional use for its handle.

AN IMPROVED CYSTOTOME

JOHN H. BAILEY, M.D., BROOKLYN

The intracapsular operation for cataract is concededly superior to extraction through an opening in the anterior capsule. Nevertheless, in the United States, and in other countries as well, the great majority of cataracts are still being removed via an incision or a tear made in the capsule, the operator employing, respectively, a cystotome or one of the several patterns of toothed or blunt forceps.

Ophthalmologists are generally agreed that in the extracapsular operation the procedure with the forceps, when properly executed (especially with an instrument in which the spring offers little resistance and the span between the blades is not greater than about 6 mm.) gives a better result than any of the various types of incision with the cystotome. The removal of a generous piece of capsule permits the lens to be expressed more easily and the cortex to be evacuated more effectively, and absorption of the remnants of the cataract is facilitated. There is less opportunity for incarceration of tags of capsule in the operative wound, the pupillary space is obviously less subject to encroach-

The instrument is made by the E. B. Meyrowitz Surgical Instruments Company, Inc., 520 Fifth Avenue, New York.

ment by capsular tissue, and the hazard of after-cataract is reduced. However, the cystotome is preferred when the capsule is thick or tough or when it is tightly stretched over the lens, as exemplified in cataracta intumescens and in pathologic sclerosis of the lens (so-called cataracta nigra). It is also the instrument of choice when only light pressure is allowed, e. g., in the presence of high myopia or fluid vitreous, in removing subluxated cataracts, in operating on patients who persist in rolling the eye during the operation and when the eye is so deeply recessed in the socket that the entrance of the forceps into the anterior chamber and its subsequent manipulation are impeded.

In performing the extracapsular operation, I probably err on the side of safety. A fine-toothed capsule forceps is introduced into the anterior chamber and carried down to the lower margin of the dilated pupil. A large piece of the anterior capsule is grasped and torn out in the usual fashion. The cystotome is now inserted, and the opening in the capsule is continued in an upward vertical direction as far as the limbus. After the cataract has been expressed, the site of the corneal incision is freely irrigated with physiologic solution of sodium chloride, which washes away whatever blood and débris that may be present, thus insuring better coaptation of the lips of the wound, an important factor in securing primary union and minimizing the danger of prolapse of the iris, the capsule or even the vitreous. At the same time, reposition of the pillars of the coloboma is accomplished, if an iridectomy has been done.

The cystotome

The point of the cystotome must be keen; otherwise, the surgeon may unconsciously use excessive pressure when incising the capsule, which may cause spilling of vitreous or retrodisplacement of the cataract, particularly in patients predisposed to such an event. On the other hand, a resisting capsule may not even be penetrated. The function of the cystotome is to cut through the anterior lens capsule; and since the capsule may vary considerably in strength, the operator must discriminate as to the degree of pressure employed—it should be adequate, neither too great nor too little. It is well to bear in mind that the capsule measures on the average about 0.02 mm. in thickness, so that even when much hypertrophied it is still, from an operative point of view, a very thin membrane.

The cystotome, even when new or just returned from the repairer, is frequently unsatisfactory. When tested on the drum, instead of going through smoothly, noiselessly and without effort, it pierces the taut kid with a click, denoting that the point lacks keenness.

The cystotome devised by me is described in the following paragraph. I also indicate wherein it differs from the one in common use.

The blade is not the delicate regulation triangle prism, but is a sturdy trapezium-shaped figure, having three of the edges, one proximal and two distal, free. The proximal edge is 2 mm. long, perpendicular to the shank,

and sharp all the way up, including a short distance on the shank in order to eliminate any drag as the cystotome is advanced along the capsule. The two distal edges meet at an obtuse angle. The part below the angle is 1 mm. long and sharp and joins the proximal edge at an acute angle, forming a fine point. The upper part is blunt, thus acting as a stop when the cataract is first engaged. The instrument is so constructed that the point and the cutting edges are heavy as well as being keen, with the result that the blade sinks into the cataract by its own weight. The handle, broader than the ordinary type, is round and polished, so that it can be readily rotated between the thumb and the forefinger. It has a mark on it to orientate the surgeon as to the direction of the point of the blade. Since the blade is broad and has a bilateral cutting edge, it can be sharpened more effectively than the ordinary instrument and with little loss of stock, an important consideration when one bears in mind that in sharpening the blade so much metal is ordinarily ground off that the efficiency of the instrument is greatly impaired.

General Review

OCULAR SYPHILIS

V. BINASAL HEMIANOPIA ASSOCIATED WITH PRIMARY OPTIC ATROPHY IN TABES DORSALIS

RALPH L. DRAKE, M.D.
PHILADELPHIA

The occurrence of binasal hemianopia, not only in tabes dorsalis but from any cause, is rare. Mooren [1] saw only 5 cases of the binasal form in 125,000 patients with ocular conditions. Schweigger [2] found 1 binasal defect in 39 cases of hemianopia. Lutz [3a] published an analysis of 84 cases of binasal hemianopia reported in the literature. In a later article,[3b] reports of 9 additional cases were published. Lutz stated that the causes of binasal hemianopia include cerebral tumors, changes in the vessels, acute inflammatory processes, cerebral syphilis, tabes dorsalis, trauma and hysteria. I shall consider here only the form due to the tabetic process.

Clinically, the atrophy of the optic nerve which occurs in tabes dorsalis appears in the preataxic stage and is often present in cases which show a paucity of neurologic signs. The onset of the visual failure is, in a vast majority of cases, unilateral, but this is soon followed by involvement of the other eye. In practically every case there is gradual progression of the atrophic process which leads to complete blindness. The appearance of the optic disk in this form of atrophy is characteristic and need not be detailed. The changes in the visual field in tabetic atrophy of the optic nerve vary in character. For the most part, these are peripheral contractions of the visual fields of the type of an interstitial peripheral neuritis, i. e., a contraction of the visual field for white and colors without central scotoma; in these cases often the entire diameter of the optic nerve may be affected by the disease process. However, certain scattered nerve fibers frequently retain their function. Also, but less commonly, cases are encountered in which there is partial loss of the visual field as a result of partial destruction of nerve fibers with well preserved function of the remainder of the fibers. These

From the Clinic for the Treatment of Ocular Syphilis, Wills Hospital, Dr. J. V. Klauder, director.

1. Mooren: Transactions of Ninth International Congress of Medicine, 1885, section II, vol. 3, p. 658.

2. Schweigger, C.: Arch. f. Ophth. **22**:320, 1876.

3. Lutz, A.: (*a*) Ueber binasale Hemianopsie, Arch. f. Ophth. **119**:423, 1928; (*b*) Ueber einige weitere Fälle von binasaler Hemianopsie, ibid. **125**:102, 1930.

partial defects of the visual field are sharply circumscribed. Hemianopic defects occur infrequently in tabes dorsalis. Fuchs [4] described 5 cases of bitemporal hemianopia, and Zimmermann [5] reported 6 cases of horizontal homonymous hemianopia in tabes dorsalis. In the complete binasal form the visual fields show various disturbances of the perception of colors. The perception of color may be normal in the temporal half or may be lost for red and green, or it may be lost for red and green in both temporal halves.

The exact nature of the pathologic process in the primary atrophy of the optic nerve of syphilitic origin has been extensively investigated by various observers. In general, the process consists of a more or less well developed infiltrative and hyperplastic change affecting the nerve sheaths which is similar to the meningeal changes found in dementia paralytica. There is also intense infiltration of the blood vessels in the parenchyma of the nerve, and at times plasma cells are seen between the nerve fibers.

These changes, which take place commonly in the region of the chiasm and intracranial portion of the optic nerve, occur, as a rule, without special clinical or anatomic signs of tissue destruction. Sometimes they are limited to a zone of peripheral degeneration similar to that which Ingvar [6] has taken to be characteristic of beginning tabetic atrophy of the optic nerve. Not infrequently in the pure form of dementia paralytica there is progression to atrophy of the optic nerve. Stargardt [7] and Igersheimer [8] have observed atrophy of the optic nerve in typical cases of dementia paralytica. Nonne [9] mentioned this, and Jakob [10] reported that in 5 cases of dementia paralytica in which there was no associated involvement of the posterior column, primary atrophy of the optic nerve was present. Stargardt [7] maintained that the parenchymal destruction is due to the infiltrating and exudative processes in dementia paralytica as well as in tabes dorsalis, a finding which has been accepted by Nissl, Spielmeyer and others. Jakob [10] found in various disturbances of the optic nerve occurring in dementia paralytica intense inflammatory changes without corresponding parenchymal damage. This observation confirmed by Behr,[11] is exactly contrary to Stargardt's find-

4. Fuchs, W.: Tabes und Auge, Wien. klin. Wchnschr. **25**:511, 1912.

5. Zimmermann, F.: Sechs Fälle von bitemporaler Hemianopsie, Ztschr. f. Augenh. **14**:362, 1905.

6. Ingvar, S.: Morphogenese der Tabes, Acta med. Scandinav. **65**:645, 1927.

7. Stargardt, K.: Ber. u. Versamml. d. ophth. Gesellsch. **37**:139, 1912.

8. Igersheimer, J.: Changes in the Optic Nerve in Tabes and General Paralysis, Deutsche med. Wchnschr. **52**:943 (June 4) 1926.

9. Nonne, Max: Syphilis und Nervensystem, Berlin, S. Karger, 1902.

10. Jakob, A.: Normale und pathologische Anatomie und Histologie des Grosshirns, Leipzig, Franz Deuticke, 1929, vol. 2.

11. Behr, C.: Anatomic Basis and Treatment of Tabetic Optic Atrophy, München. med. Wchnschr. **73**:311 (Feb. 19); 366 (Feb. 26) 1926.

ings. Kenzofujiwara [12] found only slight inflammatory changes in 19 cases of tabes dorsalis and dementia paralytica with atrophy of the optic nerve. Igersheimer [8] emphasized the following points in relation to the pathogenesis of the degenerative process: (1) The degeneration begins primarily in the periphery; (2) the atrophic process may begin in the distal as well as the proximal portion of the optic nerve; (3) it produces a patchy disappearance of the nerve fibers, and (4) the spirochetes found in the mesodermal portion of the optic nerve have not been found in the conducting substance itself.

It is generally agreed that as a rule the atrophy beings in the periphery of the nerve trunk and extends beneath the pial sheath of the nerve fibers into either one circumscribed area or multiple areas. From here it passes in a longitudinal direction as well as toward the nerve axis. The disease process may begin in any portion of the nerve, in the orbital or intracranial or even in the intracerebral course of the nerve tract.

The exact and immediate cause of the atrophy of the optic nerve is still under discussion. Stargardt [7] attributes great importance to the meningeal inflammatory reaction. However, most observers at present believe with Behr that in atrophy of the optic nerve disease of the lymph vessels and glial system plays a definite rôle. Behr [11] found not only thickening and sclerotic changes of the septal connective tissue but also a disease of the glial fiber system manifested by a severe thickening and proliferation with final degeneration. The real cause of the degeneration lies, in all probability, in a profound disturbance of nutrition of the nerve fibers which results from a certain change of the lymph vessel system of the nerve fibers and of the glial fiber system in the form of a sclerotic process, and which can be attributed to a certain predisposition resulting from a chronic intoxication due to spirochetal action.

REVIEW OF CASES FROM THE LITERATURE

The cases of tabes dorsalis with primary atrophy of the optic nerve presenting the symptom of binasal hemianopia reported up to the present time are as follows:

Gowers [13] reported a case of partial binasal hemianopia in the early stage of tabes dorsalis. The visual acuity was 1/10 in the right eye and 3/4 in the left eye. Necropsy was not performed.

Lang and Beevor,[14] in 1894, reported the case of a man, aged 33, who for two years showed a gradual decrease in his vision. He was unable to read for eight

12. Kenzofujiwara, quoted by Jakob.[10]

13. Gowers, W. R.: Manual of Diseases of the Nervous System, ed. 2, London, J. & A. Churchill, 1892.

14. Lang, W., and Beevor, C. E.: Binasal Hemianopsia in a Case of Tabes Dorsalis, Tr. Ophth. Soc. U. Kingdom **14**:246, 1894.

months prior to examination. The pupils were of the Argyll Robertson type. The patellar reflexes were absent, and the gait was ataxic. There were lancinating pains in both lower extremities. The vision was 6/24 in the right eye and 6/60 in the left eye. Necropsy was not performed.

Ole Bull,[15] in 1895, reported the case of a man, aged 44, who showed binasal hemianopia. He had headache, pains in the legs and generalized weakness for three years. The patellar reflexes were absent, and the Romberg sign was

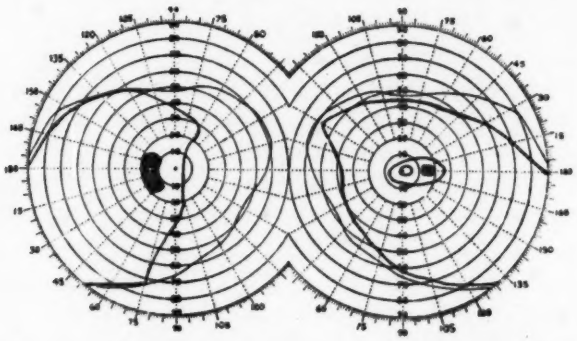

Chart 1.—Visual fields on Feb. 28, 1931. The illumination was 7 foot-candle power and the size of the stimulus, 10 mm. The crossed area represents the blind spot. No colors were recognized in the field of the left eye. The right eye showed a small central color field for blue and red. Green was not recognized.

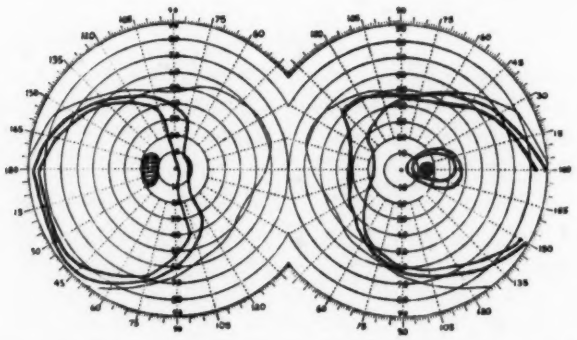

Chart 2.—Visual fields on April 2, 1931. The illumination was 7 foot-candle power, and test objects of 10 and 5 mm. were used. No colors were recognized in the left eye.

present. The gait was normal. Binasal hemianopia was observed for one month. There then developed a gradual loss of vision leading to amaurosis. Examination of the fundus revealed bilateral atrophy of the optic nerve. Vision was 1/48 in the right eye and 1/18 in the left eye. Both eyes showed loss of perception. Necropsy revealed degeneration of both optic nerves.

15. Bull, Ole: Perimetrie, Bonn, F. Cohen, 1895, p. 191.

Rönne,[16] in 1912, reported the case of a man, aged 40, who had had an initial syphilitic lesion six years previously. There had been a diminution of vision in the left eye for three months. The patellar reflexes were both decreased. There was a zone of abdominal hypesthesia. The cerebrospinal fluid showed lymphocytosis. Binasal hemianopia was observed for four months. There was bilateral primary atrophy of the optic nerve. Vision in the right eye was 6/12 and in the left it was limited to perception of fingers only. Necropsy was not performed.

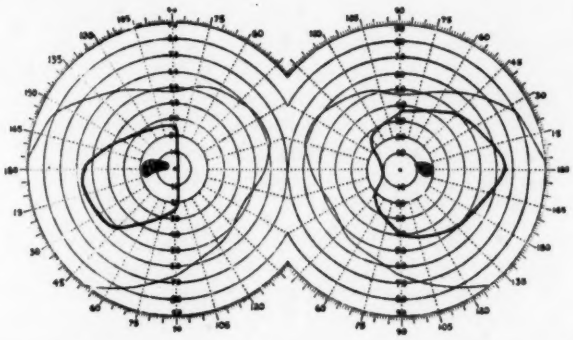

Chart 3.—Visual fields on Sept. 14, 1931. The illumination was 7 foot-candle power and the size of the stimulus, 5 mm. Marked progression of the atrophic process is shown.

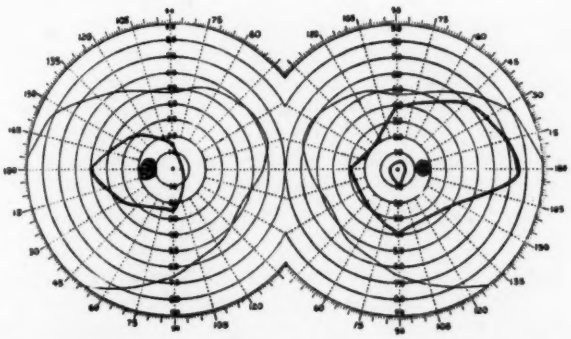

Chart 4.—Visual fields on Nov. 30, 1931. The illumination was 7 foot-candle power. In the left eye no 1 cm. colors were recognized. A 2 mm. test object was used for the form field. In the right eye there was no recognition for 1 cm. red and green, but the area showed recognition for blue.

Heed and Price,[17] in 1914, reported a case in which there was a diminution of vision for three months. The patellar reflexes were diminished, and the achilles

16. Rönne, H.: Ueber die Bedeutung der makularen Aussparung im hemianopischen Gesichtsfelde, Klin. Monatsbl. f. Augenh. **50**:452, 1912.

17. Heed, C. R., and Price, G. E.: Binasal Hemianopsia Occurring in Course of Tabetic Optic Atrophy, J. A. M. A. **62**:771 (March 7) 1914.

reflexes were absent. The Wassermann reaction was negative. There was a definite binasal hemianopia of three months' duration. The atrophy of the optic nerve was primary. The vision was 4/60 in the right eye and 6/60 in the left eye. Necropsy was not performed.

Lutz,[3a] in 1928, reported the case of a patient who gave a history of a primary lesion twelve years previously. For one year there was a sensation of giddiness. For the past three years he had noticed a gradual and progressive loss of vision. He then received an injection of arsphenamine, eight days after which a sudden loss of vision developed. Examination revealed a positive Wassermann reaction of the blood, absence of both patellar and achilles reflexes and bilateral primary atrophy of the optic nerve. There was no Romberg sign or ataxia, and the pupils reacted normally to light. Vision in the right eye was 2/20. Hand movements were seen at 1 meter with the left eye. There was no color perception. The use of arsphenamine was discontinued. Two years later the central vision had remained the same, but the visual field had improved. In the left eye there was an absolute nasal hemiaopia without perception of color. One year later, examination revealed the same condition.

REPORT OF A CASE

History.—A man, aged 36, referred from Dr. Chance's clinic on March 2, 1931, complained of dimness of vision in both eyes. There was a history of a genital lesion at the age of 15. Three years prior to admission he noticed blurring of vision in the left eye. Two months later vision in the right eye began to fail. This visual failure gradually progressed up to the time of admission. There were no other complaints.

Neurologic Status.—Both pupils were moderately dilated and equal, but irregular. They reacted in accommodation-convergence, but were fixed to light stimulation. On admission vision in the right eye was 6/60 and in the left eye, 4/60. There was a definite bilateral primary atrophy of the optic nerve. The other cranial nerves were normal. The only sensory disturbance noted was a loss of vibratory sense over both lower extremities and the sacrum. The patellar and achilles reflexes were absent on both sides. All cerebellar tests were performed normally. There was a positive Romberg sign. The gait was normal.

The serologic findings were as follows: The Wassermann reaction of the blood and cerebrospinal fluid was strongly positive. The cerebrospinal fluid showed a marked increase in globulin and 10 lymphocytes. The colloidal gold test gave a syphilitic curve.

Treatment and Course.—Potassium iodide in doses of 15 grains (0.97 Gm.) was given by mouth three times daily. A course of twelve consecutive doses of 0.2 Gm. of soluble bismuth suspended in oil was given intramuscularly. Neoarsphenamine was given in increasing dosage from 0.4 to 0.6 Gm. once each week. Intravenous injections of sodium iodide in doses of 25 grains (1.62 Gm.) were given weekly. Swift-Ellis treatments were given every other week, and were continued for thirteen months. At the end of that time the vision in the right eye was 2/30 and in left eye, 1/30. Unfortunately, further observation was impossible owing to the patient's failure to return to the clinic.

COMMENT

In the case reported here the visual acuity decreased rapidly in spite of intensive therapy. The cases of primary optic atrophy associated with binasal hemianopia usually show rapid progression of the atrophic

process to complete blindness. The studies of the visual fields in this case illustrate clearly the rapid progression of the process. It is likely that more cases of binasal hemianopia would be recognized if routine studies of the visual fields were performed on all patients with tabes dorsalis who have ocular symptoms.

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Correspondence

ORBITAL LYMPHOMA IN CHRONIC LYMPHATIC LEUKEMIA

To the Editor:—The article entitled "Orbital Lymphoma in Chronic Lymphatic Leukemia," by Dr. Martin Cohen (ARCH. OPHTH. **11:** 617 [April] 1934), is of peculiar interest to me as it gives such a clear picture of one well defined variety of orbital lymphomatous tumefaction. In his last paragraph, the author stated that "a study of the literature relating to these and to allied conditions reveals various interpretations with respect to the classification of orbital lymphomatoses as well as to their rare occurrence."

I cannot quite agree with the view that the orbital lymphomatoses are rare in all parts of the world, relative to other tumors of the orbit, but I freely admit that they are open to various interpretations with regard to classification. About ten years ago it occurred to me that if one included all the conditions associated with increase of lymphomatous (sometimes termed lymphoblastomatous) tissue in the orbit that in this part of the world, at least, lymphomas and allied conditions constituted, as a group, one of the most frequent causes of tumefaction of the orbit. In the *Lancet* for Jan. 19, 1929, I published an article in this connection, suggesting a classification, or rather an analytic arrangement, of the types of cases met with in the clinic of the Government Ophthalmic Hospital at Madras, India. I stated there that of the various orbital neoplasms (using the term in its widest sense) seen in this clinic the lymphomatous group came third in frequency. Unfortunately, articles prepared for general journals are apt to be so condensed that they suffer from a lack of clarity, and I must confess that my article in the *Lancet* does not appear as lucid as I now wish, so far as classification is concerned. Those interested in the subject, however, will follow with a little difficulty the arrangement indicated and make out that a number of distinct conditions are met with here in which an increase of lymphoid tissue in the orbit is a prominent feature. Included among these conditions, Mikulicz' disease and lymphoblastoma with myelogenic changes in the blood occur fairly regularly, and a year seldom passes without the occurrence of two or three cases which come under these two headings. There is no record of a well defined case of chronic lymphatic leukemia with orbital lymphomatous masses such as that reported by Dr. Martin Cohen, so that this member of the group is probably especially rare here. In view of the experience in this hospital as to the relative frequency of these conditions, it might be of interest to point out that such cases as have been seen are discussed briefly in the reports of this hospital for 1922 and following years, and that their occurrence was brought up to date in the report for 1929 and in the volume of the *Lancet* referred to previously. The further occurrence of such cases has not been systematically recorded, although during the past six months a case of lymphoblastoma of the orbit in a child with myelogenic changes in the blood was observed in which the rod-shaped cell inclusions in the myelocytes (referred to in the *American Journal of Ophthalmology* **10:** 482, 1927) were very pronounced. With regard to these

rod-shaped bodies, I have not yet been able to get a satisfactory explanation as to their significance. In another recent case the lymphomatous massing was anterior to the septum orbitale; there was no proptosis. Classification is not easy, and, as I mentioned previously, my attempt is not very clear, but I have no hesitation in saying that there are more than the four clinical types of lymphomas designated in Hocheim's classification, In fact, there are more than six well defined types. Sections through the lymphomatous cell masses in any variety, when advanced, do not help much in making a diagnosis. Without a blood picture and a general examination of the patient, the cytologic appearances are extraordinarily similar except in the Coats' variety in which large aggregations of cells are conspicuous by their absence and the very sparseness of the lymphomatous picture is characteristic and curiously out of proportion to the tumefaction.

ROBERT E. WRIGHT, M.D., C.I.E., LIEUT.-COL., I. M. S.,
Superintendent, Government Ophthalmic Hospital, Madras, India.

DIVERGENCE EXCESS

To the Editor:—I have read Professor Bielschowsky's paper on "Divergence Excess" and the discussion which followed it in the August issue of the ARCHIVES OF OPHTHALMOLOGY (12: 157, 1934) with much interest and profit. There is one statement, however, which it seems to me should not be allowed to pass without comment. It is as follows: "One can obtain a result as reliable as that obtained by the occlusion test in the following way: By carefully examining the duction power one determines the strongest prism which the patient is able to overcome. At the moment when diplopia appears the rotation prism is replaced by a dark red glass. A patient with exophoria will see crossed double images, the distance of which from each other corresponds initially to the angle of the strongest prism the patient had been able to overcome but very soon diminishes by a few degrees and then becomes stationary as long as the fusion tendency remains destroyed by the dark glass. This stationary deviation gives the amount of true exophoria, and the difference between this and the amount of prism divergence indicates the effect of active divergence."

This statement carries three implications: first, that the total duction power can be determined by finding the strongest prism with which a patient can maintain single vision; second, that the exophoria following this determination is always less than the total abduction, and third, that the reliability of the occlusion test is recognized as compared with other tests. The most important of these implications is the assumption that the exophoria is less than the total abducting power, so determined. It would be easy to put the test to the proof by following it by a careful prolonged occlusion test. This, however, happens to be unnecessary. In my monograph on the occlusion test, published in 1924, a chapter (no. 8) is devoted to a study of the relation of abduction to exophoria. The difference in abduction before and after occlusion, and also a comparison of the preocclusion abduction and postocclusion exophoria, are there noted. In 104 cases the abduction was measured before and after

occlusion, and in all but 4 cases there was an increase, sometimes very great, thus from 1 to 10 degrees, from 6 to 13 degrees and, in the most extreme case, from 13 to 31 degrees. In other words, it is evident that the measure of the prism abduction before occlusion is not a reliable indication of its total power. The relation between the preocclusion abduction and the postocclusion exophoria was noted in 299 cases. In 195 cases the final exophoria was less than the preocclusion abduction. In 28 cases the two were equal, and in 76 cases, or 25 per cent, the postocclusion exophoria exceeded the preocclusion prism abduction. The most extreme case showed preocclusion abduction of 13 degrees and postocclusion exophoria of 30 degrees.

The principle of the method of Bielschowsky is not new. It was used by me (and no doubt by others) many years ago and abandoned partly because of its low value, and completely when the occlusion findings became known. The patient already referred to twice is an example. A young woman, emmetropic in each eye, showed exophoria of 4 degrees at the primary test; the prism abduction was 13 degrees and after testing it the exophoria went up to 8 degrees. A week's occlusion brought the abduction to 31 degrees and the exophoria to 30 degrees.

It seems to be conceded by Professor Bielschowsky that the prolonged occlusion test is reliable, if somewhat inconvenient, but the inconvenience is a matter of small moment compared with the sufferings of the patient and the relief usually obtained. So far no method has been devised which can take its place, and it seems improbable that any will be found, unless some myoplegic is discovered capable of acting on the extrinsic muscles as a cycloplegic does on the accommodation.

The dependence of accommodative spasm on latent heterophoria is also dealt with in the monograph referred to.

F. W. Marlow, M.D., Syracuse, N. Y.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Anatomy and Embryology

THE CILIARY MUSCLE AND DESCEMET'S MEMBRANE. H. DE VILLIERS, Brit. J. Ophth. **17:** 675 (Nov.) 1933.

The author states that the ciliary muscle ends anteriorly in connective tissue. Much of this tissue is attached to the posterior border of the scleral spur, but a good deal passes straight forward, avoiding the scleral spur altogether, toward the "end of Descemet's membrane." From the anterior border of the scleral spur trabeculae pass forward to the "end of Descemet's membrane" and to the inner corneal lamellae. Posteriorly the ciliary muscle is attached directly to the whole of the posterior portion of the eye. A neighboring tissue is interposed between the muscle and its ultimate attachment, viz., the choroid. Anteriorly the ciliary muscle is attached directly, according to the author's view, to the whole of the cornea. A neighboring tissue is interposed between the muscle and its ultimate attachment, viz., the scleral spur.

The scleral spur has sufficient connection with the fibers of the anterior attachment to cause its anterior portion to move with the fibers as the ciliary muscle contracts and relaxes, thereby causing the canal of Schlemm to dilate and collapse—a matter of the greatest importance to the intra-ocular fluid circulation, especially in cases of raised intra-ocular tension.

From the evidence described and the opinions of a number of anatomists quoted as to the histology of the parts under consideration, the question arises in the author's mind whether Descemet's membrane should not be regarded as the anterior tendon of the ciliary muscle.

W. ZENTMAYER.

EMBRYOLOGIC AND ANATOMIC STUDIES OF THE SCLERAL SPUR IN THE HUMAN EYE. F. FISCHER, Arch. f. Ophth. **131:** 318 (Dec.) 1933.

The development of the scleral spur was studied in human embryos of various stages (from 8 to 49 cm. in length). The first anlage was found in embryos a little over 8 cm. long. It consisted of connective tissue fibers running equatorially in the uveal tissue which lies inward of the anterior sclera. Those fibers were first very loosely arranged; later on they moved closer together and—in sections perpendicular to the surface of the globe—occupied a wedge-shaped area with its sharp edge pointing backward. The whole formation later on developed into the scleral spur and the so-called scleral roll (*Wulst*) of Virchow. The most external tendon fibers of the ciliary muscle could be seen to go through the scleral spur and to connect with the trabeculae of the pectinate ligament of the iris. The more centrally located fibers of the ciliary muscle did the same thing without touching any part of the scleral spur.

In adult human eyes Fischer distinguishes between four different types of scleral spurs as they present themselves in meridional sections. Type 1 is characterized by a rather short and plump form. Type 2 is thin and long. In both, the spur points straight forward. Type 3 shows the most conspicuous spur formation inasmuch as the bulk of the spur protrudes considerably into the interior of the eye. Furthermore, its tip bends the other way, i. e., toward the angle of the anterior chamber. Type 4 stands almost perpendicular to the inner surface of the sclera, so that the floor of the angle of the anterior chamber is flush with the inner scleral contour. In both eyes of the same patient the same type of scleral spur is found.

Glaucoma apparently develops in eyes with scleral spurs of any of the aforementioned types. Fischer believes from his anatomic studies that in glaucoma the scleral spur protects the canal of Schlemm from being compressed. In cases of hydrophthalmos the scleral spur is absent if the canal of Schlemm is absent. The pectinate ligament is always present though badly damaged.

The scleral spur is commonly believed to be the place of insertion for the meridional fibers of the ciliary muscle. This is only partly true, for most of the tendon fibers go through the scleral spur and fuse with the pectinate ligament. Fischer believes that the scleral spur is the determining factor in the development of the scleral groove and of Schlemm's canal. Besides, it determines, to some extent, the shape and the rigidity of the anterior segment of the eye.

P. C. KRONFELD.

Color Sense

THE COLOR SENSE OF CARRIERS OF COLOR-BLIND FAMILIES. M. WIELAND, Arch. f. Ophth. **130**: 441 (Sept.) 1933.

The mothers of color-blind men were tested with the anomaloscope of Nagel and with a combination of the step-photometer of Zeiss with the apparatus of Krueger. The average Rayleigh equation of all carriers (the mothers of deuteranopes and of protanopes) contained decidedly more green than that of the normal controls. The thresholds for red and green were somewhat higher in a certain portion of all carriers. Thus it is proved that anomalies of color sense occur among carriers. It is justified to assume that in women the combination of a normal gene with the gene of anomalous color sense occasionally produces borderline cases. In men borderline cases cannot occur because the presence of the gene of anomalous color sense produces the outspoken anomaly.

P. C. KRONFELD.

THE ANATOMIC AND PHYSIOLOGIC FOUNDATION OF COLOR VISION. M. KARBOWSKI, Arch. f. Ophth. **130**: 469 (Sept.) 1933.

The transformation of light energy into stimulation of the receptors in the retina is made the subject of a theory of color vision in which old and new ideas are combined. The actual receptors are the outer limbs of the cones. They consist of platelets which are supposed to

possess the quality of specific absorption for a certain wavelength and also for some of the neighboring longer waves. The function of the myoid portion is thought to be to bring the platelet which is suitable for the perception of the respective wavelength in the correct focal plane. The author assumes the presence of any number of platelets for the perception of the various shades and hues. Color blindness results from a congenital or acquired absence of some of the platelets. The varying sensations produced by constant chromatic stimuli in the various parts of the visual field are explained on the basis of chromatic aberration. The paper is highly speculative. P. C. KRONFELD.

Conjunctiva

PERMANENT CURE OF VERNAL CONJUNCTIVITIS BY CAUTERIZATION WITH CARBON DIOXIDE SNOW. J. STREBEL, Klin. Monatsbl. f. Augenh. **91**: 512 (Oct.) 1933.

All cases of vernal conjunctivitis of the palpebral and tarsal form treated by Strebel during a period of twelve years were cured by cauterization with carbon dioxide snow. To the time of his report, in some cases twelve years after the treatment, recurrences had not been observed, nor did scars remain in the lids. Limbal efflorescences were treated in the same manner. The method is superior and entails less risk than the application of radium. It is carried out in the following manner: After local anesthesia has been obtained with an injection of nupercaine and following application of a contact glass, the spray of carbon dioxide snow is applied repeatedly to the pathologic changes in the conjunctiva until they are covered by a layer of ice. The cobblestone-shaped prominences are removed with scissors and a cataract knife, and the bleeding surface is thermocauterized.

K. L. STOLL.

SUBCONJUNCTIVAL HEMORRHAGE AS VICARIOUS MENSTRUATION OF THE CONJUNCTIVA. REPORT OF TWO CASES. F. POOS, Klin. Monatsbl. f. Augenh. **91**: 661 (Nov.) 1933.

Ocular disturbances synchronous with menstruation are discussed, and two cases are reported in which hemorrhages and suffusions in the conjunctivae occurred simultaneously with the onset of the menses.

1. A healthy, slightly adipose student, aged 22, suffered from amenorrhea with general disturbances for several years. Subcutaneous injection of a pituitary preparation on two consecutive days was followed by slight menstruation and bilateral hemorrhages in the conjunctiva from the limbus downward into the lower fornix. The source of the hemorrhages could not be detected with the corneal microscope. Intraocular hemorrhages or other ocular disturbances were absent.

2. A woman, aged 29, began to menstruate after strenuous, close work. The following morning she noticed an extensive hemorrhage near the temporal canthus of the right eye. Menstruation had been normal previously, and she had never been sick. K. L. STOLL.

Cornea and Sclera

THE ADJUVANT FACTORS OF INTERSTITIAL KERATITIS. F. TERRIEN, Arch. d'opht. **50**: 614 (Sept.) 1933.

Terrien discusses certain factors which appear to play an important part in the onset of interstitial keratitis. Since the Wassermann test is positive in almost all cases, he suggests that there must be some precipitating event for the breaking out of the keratitis. In no other way can its late appearance be explained if the spirochete or its toxins are alone the cause. He discusses the difficulties encountered in attempting to explain the process as being due to the presence of the spirochete in the cornea, pointing out that the spirochete may be present in numbers in the cornea of a fetus or new-born infant without any reaction, and that it has only rarely been found in the corneal tissue of patients with active keratitis. He rejects Löwenstein's theory of emboli and blocking of the anterior ciliary vessels because it does not explain the bilateral character of the disease. He does not believe that Elschnig's theory of toxins in the blood or that of Igersheimer is completely satisfactory, and further points out the defects in the anaphylactic explanation of the condition. Whatever the explanation for the onset may be, aside from the undeniable syphilitic basis, Terrien believes that there are certain precipitating factors for its outburst. The first of these is trauma. Trauma can of itself produce an interstitial keratitis, according to the reports in the literature and what may sometimes be observed in cases of recurrent erosions. On these grounds it is possible, in his opinion, to recognize a traumatic origin. He describes three cases. He believes, however, that only 12 of 94 reported cases can be accepted. The conditions to be met before accepting the possibility of this exciting factor are (1) integrity of the organ and absence of all other objective disturbances before the accident, (2) certainty of trauma and (3) rapid development of the keratitis within a few days. Operative trauma may also be responsible for the onset of interstitial keratitis. Some cases have been reported in the literature, and Terrien describes 2 more instances. In addition to the part played by trauma, Terrien points out the possible relationship which the endocrine glands may have. He draws attention to age and sex as factors. In a series of 510 cases, 80 per cent occurred between the ages of 6 and 25 years; 60 per cent of those occurring up to the age of 20 were observed in females; after the age of 20 the rate was the same for both sexes. He correlates these statistics with the onset of menstruation, and suggests that there may also be some relationship to a tuberculous infection, the combination resulting in an outbreak of interstitial keratitis. A certain number of patients present true adiposogenital dystrophy. He describes a case occurring in a patient with infantilism in whom mercurial treatment alone failed to be beneficial; with the addition of pluriglandular extracts rapid improvement took place. The point that Terrien seeks to emphasize is the relation between interstitial keratitis and disturbances of the endocrine functions and the great benefit to be derived by the addition of glandular therapy to mercurial treatment.

S. B. MARLOW.

TREATMENT OF FAMILIAL DEGENERATION OF THE CORNEA: REPORT OF TWO CASES OF THE GROENOUW TYPE. LOTTE HAGER, Klin. Monatsbl. f. Augenh. **91:** 593 (Nov.) 1933.

Prompted by Loewenstein's favorable report on his therapy for familial degeneration of the cornea (*Klin. Monatsbl. f. Augenh.* **82:** 752, 1929) two patients with the Groenouw type were satisfactorily treated in the same manner at the University Eye Clinic in Tübingen. The treatment consists in the production of intense hyperemia by daily massage of the eyes with a salve composed of ethylmorphine hydrochloride and mercury, diathermy and the administration of iodine hypodermically and saline solution subconjunctivally.

The first patient, a woman, aged 35, had at the center of the cornea fine subepithelial nodules and star-shaped changes in the parenchyma. Coarser opacities were observed in the superficial and finer ones in the deeper layers. The space between the opacities showed some fine clouding. Vision rose from 5/18 to 5/8 of the normal in each eye. The dense opacities remained unchanged, but the veil between them became decidedly clearer.

The second patient, a girl, aged 17, had myopia of 6 diopters in the right eye and of 10 diopters in the left, with vision of 5/18 in each eye. Nodular opacities were noticed in the center of the cornea in both eyes; the periphery was clear. The nodules were slightly opalescent, had irregular borders and were located chiefly in Bowman's membrane though some were in the deeper layers of the parenchyma; they were distinctly separated and the interspaces were clear in the right eye, while they were confluent, forming larger figures connected by a diffuse gray veil, in the left.

The nodules were reduced in number, and some decreased in size; some of those in the left cornea became distinctly separated, and the interspaces grew clearer. Vision was finally 5/5 in the right eye and 5/6 in the left. The result of this therapy depends on the willingness of the patient to remain under treatment sufficiently long, lest recurrences occur, as in the first case. The time was too short to decide whether the results in these cases were permanent.

K. L. STOLL.

Experimental Pathology

EXPERIMENTAL TUBERCULOSIS OF THE EYE. W. A. OHMART, Am. J. Ophth. **16:** 773 (Sept.) 1933.

The author briefly reviews the literature of tuberculosis of the eye. He experimented on fifteen rabbit eyes, injecting a very diluted suspension of virulent tubercle bacilli into the ciliary body. The microscopic observations are given, and the following conclusions made:

1. A localized form of tuberculosis could be produced in the ciliary body experimentally, and in a large proportion of the animals the primary lesion could be confined to the pars plana at the onset of the disease.

2. Migration from the posterior portion of the ciliary body occurred in three directions: (*a*) into the vitreous, (*b*) posteriorly into the

choroid, occasionally into the retina and optic nerve, and (*c*) anteriorly into the iris, anterior chamber, ligamentum pectinatum and episclera.

3. The vitreous was involved in all but two eyes, and the experiments would lead one to believe that vitreous exudate was present in the tuberculosis of the posterior portion of the ciliary body.

4. The vitreous exudates in the earlier stages were characteristic of tuberculosis and histologically were true tubercles, consisting of epithelioid cells, small round cells and often fibroblasts, and occasionally having caseated centers.

5. The vitreous tubercles varied from 0.1 to 0.5 mm. in diameter and were usually round or oval, but occasionally were club-shaped.

6. A generalized cloudiness of the vitreous occurred and was due to the exudation of fibrin and isolated cells.

7. In the later stages the cells were more numerous in the posterior vitreous in front of the so-called hyaloid membrane.

8. The retina was astonishingly free from tuberculous invasion, and when it was affected the extension was from the choroid in a vast majority of cases.

9. A perivasculitis of the retinal vessels occurred in several eyes, and apparently the extension came from the vitreous rather than along the perivascular lymph spaces.

10. In the cases of perivascular extension, involvement was confined to the nerve fiber layer of the retina in the region of the affected vessel. Extension did not take place into the deeper layers of the retina.

11. In all cases multiple tubercles eventually appeared in the choroid.

12. Anterior migration occurred much less frequently than posterior extension. Gilbert-Koeppe nodules were found in four eyes and deposits on the posterior surface of the cornea in only five cases.

13. Fibrinous exudate into the anterior chamber was found histologically in the majority of eyes.

14. In the anterior chamber cells were found histologically in none of the cases.

15. The ligamentum pectinatum was invaded in one case.

16. In only one instance extension occurred into the episcleral tissue by the scleral corneal margin.

17. Four of the animals were made allergic by previous introduction of tubercle bacilli into other portions of the body. The disease was more widespread and ran the course much more rapidly than in those that were nonallergic.

W. S. REESE.

ACTION OF BENZODIOXANE DERIVATIVES ON EXPERIMENTAL EXOPHTHALMOS. J. JUSTIN-BESANÇON, D. BOVET, D. KOHLER and S. SCHIFF-WERTHEIMER, Compt. rend. Soc. de biol. **114:** 1082, 1933.

In the dog an intravenous injection of 5 mg. of ephedrine per kilogram provokes regularly marked and prolonged protrusion of the eyeball. If an intravenous injection of yohimbine (2 mg. per kilogram) is then administered, retrocession follows. Diethylaminomethylbenzodioxane (20 mg. per kilogram) acts similarly.

J. E. LEBENSOHN.

EXPERIMENTS WITH INOCULATION OF HERPES VIRUS. K. KUCHNER, Klin. Monatsbl. f. Augenh. **91**: 485 (Oct.) 1933.

Scrapings of epithelium from the corneas of thirty-six patients with herpes of the cornea produced the same disease in the corneas of rabbits. On or before the twelfth day after the manifestation of subjective ocular symptoms in the patient, three vertical and three horizontal scratches were made with a discission needle in the cornea of a rabbit and the scrapings from the patient's cornea applied with a spatula. The scrapings from thirty-two of these thirty-six patients produced small, superficial infiltrations along the scratches, with fine ramifications resembling dendritic figures. Positive results were obtained with scrapings from only two of five patients with disciform keratitis, also inoculated before the twelfth day. This may have been due to the fact that the onset of the subjective disturbances, which are usually minor in the beginning, escaped the knowledge of the patients. A negative result followed inoculation in a case of keratitis filiformis in which disciform keratitis had developed a few weeks after the vesicles of simple herpes of the forehead had dried. Simple herpes, colds, grip and pneumonia seem to cause corneal herpes more frequently than has been hitherto suspected. Inoculations of scrapings in acute or chronic recurring erosions of the cornea failed to produce a reaction on rabbits' corneas. The herpetic origin of these erosions is therefore doubted.

K. L. STOLL.

General Diseases

CYANOSIS OF THE RETINA IN CERULEAN DISEASE. N. A. PLETNEVA, Sovet. vestnik oftal. **3**: 253, 1933.

Two young female patients suffered from congenital stenosis of the pulmonary artery. There was general cyanosis (*Blausucht*) of the skin and of all visible mucous membranes. Polycythemia with a high hemoglobin index (158 per cent and 112 per cent) was recorded for the patients. The lids were cyanotic; the conjunctival vessels were distended and of a violet hue. The vision and the pupils were within normal limits. The fundi presented characteristic changes. The retinal veins and arteries were greatly distended, all small vessels were visible, the disks were hyperemic, and the retinas were dark violet-blue. The diagnosis was cyanosis retinae due to congenital defect of the right side of the heart.

O. SITCHEVSKA.

OCULAR COMPLICATIONS IN TRICHINOSIS. A. P. DIBAN, Sovet. vestnik oftal. **3**: 288, 1933.

On a collective farm a group of thirty-seven persons suffered from trichinosis. They had all eaten of pork in which trichinae were found on microscopic examination. Their ages ranged from 6 to 43 years. The earliest onset of the illness was on the fourteenth day, the latest on the twenty-eighth day, after partaking of the pork. The chief indi-

cation was edema of the face and of the lids, which was observed in thirty patients on the first day of illness, and in only a few on the third or the fourth day. Exophthalmos and limitation of motion of the eyeball were observed in four patients for a few days. Convergence insufficiency was recorded in all cases. Subconjunctival hemorrhages at the insertions of the rectus muscles were observed in four, and distention of the conjunctival blood vessels in seventeen, patients. The fundus changes were mild and transient; edema of the retina and striated hemorrhages were seen in the fundi of three patients. Four patients complained of blurred vision. The ophthalmoscope revealed hyperemia of the disk, which cleared up within a week.

O. SITCHEVSKA.

OPHTHALMIC OBSERVATIONS IN ONE HUNDRED CASES OF MALARIA. A. MOTEGI, T. KAN, S. KO and S. SYU, Acta soc. ophth. jap. 38: 2 (Jan.) 1934.

Forty-six of 100 patients with malaria presented slight ophthalmoscopic changes consisting in grayish opacities of the retina radiating from the disk with a number of small punctate hemorrhages. These changes all disappeared. Yellowish discoloration of the bulbar conjunctiva was present in 1 per cent of the patients; it was produced by disintegration of red blood cells.

A. KNAPP.

Hygiene, Sociology, Education and History

THE MENACE OF HEREDITARY BLINDNESS. J. M. BICKERTON, Brit. M. J. 1: 93 (Jan. 20) 1934.

Bickerton considers that in about one quarter of all cases blindness is hereditary. He illustrates this in various ocular conditions, including myopia, retinitis pigmentosa, optic atrophy, congenital and senile cataract, ectopia lentis, nystagmus, maculocerebral degeneration and microphthalmos, by giving pedigrees covering from two to six generations. Of interest is a pedigree of aniridia: One blind man with this defect had thirteen children (100 per cent), sixty-one grandchildren (of sixty-three) and thirty-nine great-grandchildren (of forty-two) similarly affected.

Bickerton thinks that there is probably a hereditary predisposition in glaucoma, that the disease may be due to a hereditary anaphylaxis or abiosis, and that it may arise early in life as juvenile glaucoma.

Glioma is considered to be a recessive characteristic, which is lethal when present in a homozygous condition.

As possible remedies for hereditary blindness he suggests constructive birth control, sterilization of mental defectives, a review of the ancient and obsolete abortion laws, euthanasia for infants with gross defects and a Wassermann test during or before pregnancy.

An explanation of the symbols used in the pedigrees can be found on page 264 of the same journal (Feb. 10, 1934).

W. F. DUGGAN.

Injuries

DERMATO-OPHTHALMITIS DUE TO THE EYELASH DYE LASH-LURE. C. E. HARNER, J.A.M.A. **101:** 1558 (Nov. 11) 1933.

Harner reports three cases. All occurred in woman as the result of having the eyelashes or brows, or both, dyed with Lash-Lure. The first patient presented a second attack of dermatoconjunctivitis with keratitis. In the second, corneal ulcers and iritis developed in addition to the dermatoconjunctivitis. The Wassermann reaction was four plus. The resulting vision was: right eye, 6/60; left eye, 6/7½. The third case was one of dermatoconjunctivitis. Harner suggests that in the first case an allergic factor was present.

W. ZENTMAYER.

SEVERE EYE SYMPTOMS DUE TO DYEING THE EYELASHES. O. P. BOURBON, J.A.M.A. **101:** 1559 (Nov. 11) 1933.

A case of inflammation of the eyelids and conjunctiva in a woman, the result of the use of "Larieuse," a "coloring for hair and beard," is reported by Bourbon. The picture as a whole strongly indicated the action of a chemical irritant and the absorption of material that had a pronounced toxic effect, inducing a profuse and stringy secretion. There were severe edema and chemosis.

W. ZENTMAYER.

CORNEAL ULCERATION FOLLOWING USE OF LASH-LURE. A. W. MCCALLY, A. G. FARMER and E. C. LOOMIS, J.A.M.A. **101:** 1560 (Nov. 11) 1933.

The patient was a woman, aged 38. On the day following the application there was intense edema of the lids, with chemosis of the conjunctiva and some epithelial involvement of the cornea. The corneal condition went on to sloughing, despite paracentesis to relieve tension. At present there are a large dense leukoma in the right eye and a less dense opacity in the lower half of the left eye, with enough infiltration above to reduce vision to the perception of light, as in the right eye.

W. ZENTMAYER.

EYELASH DYE (LASH-LURE) DERMATITIS WITH CONJUNCTIVITIS. R. C. JAMIESON, J.A.M.A. **101:** 1560 (Nov. 11) 1933.

The patient was a woman, aged 40. Three days after an application of Lash-Lure the eyelids became red and swollen, and the conjunctiva became inflamed. Relapses occurred on several occasions over a period of three months.

W. ZENTMAYER.

Lens

METABOLISM OF THE NORMAL AND CATARACTOUS LENS. P. C. KRONFELD, Am. J. Ophth. **16:** 881 (Oct.) 1933.

The metabolism of the lens cannot be expressed in definite terms, as knowledge of it is incomplete and one cannot compare it with that of any other organ of the body. It is greatest at the surface of the

lens and least at its center. In the normal lens, 2.4 mg. of sugar and 0.3 mg. of oxygen are consumed daily. Little is known of the metabolism of the cataractous lens.

W. S. REESE.

SOME REMARKS ON THE ETIOLOGY OF CATARACTS. A. J. BEDELL, Am. J. Ophth. **16:** 945 (Nov.) 1933.

This interesting article and its discussion do not lend themselves to abstracting. The author believes that the simplest and most comprehensive scheme for the classification of cataracts is that which considers the embryonic, fetal, infantile and adult nuclei, the cortex and the capsule as integral but separable parts of the lens. He does not believe that one can as yet, except in developmental or growth opacities and gross injuries, tabulate causes and correlate them with distinctive pictures presented by the lens on examination with the slit lamp. The necessity of dilating the pupil in making such an examination is emphasized.

W. S. REESE.

THE POSSIBLE INFLUENCE OF IMMUNOLOGICAL FACTORS IN THE PRODUCTION OF CATARACT. A. C. WOODS and E. L. BURKY, Am. J. Ophth. **16:** 951 (Nov.) 1933.

The authors discuss the physiochemical properties of lens protein, the antigenic properties of lens protein, the experimental production of cataracts by immunologic procedures, immunologic reactions to lens protein in normal and cataractous human beings and theories of the possible relationship of lens protein to cataract. They conclude that suggestions and theories on the causation of senile cataract through the physiochemical and immunologic properties of lens protein are not proved, though from the time of Uhlenhuth's investigations thirty years ago, numerous interesting observations have been made. These observations are stimulating and naturally lead to speculation as to their possible importance in the problem of cataract.

W. S. REESE.

EXTRACTION OF CATARACT IN HEMOPHILIA: REPORT OF A CASE. R. SCHNEIDER, Klin. Monatsbl. f. Augenh. **91:** 365 (Sept.) 1933.

A man, aged 52, who had suffered from "rheumatism" for many years, had a cataract of his left eye extracted. A conjunctival flap was made and an iridectomy performed. The anterior chamber was filled with blood on the two following days, and the lids were swollen; the conjunctival sac was filled with coagulated blood, and the wound of the conjunctiva and cornea reopened after the patient vomited during the third night. He admitted on questioning that he had hemophilia, which he did not mention, as the possibility of ocular hemorrhages was unknown to him. The oozing of blood finally ceased after the palpebral fissure was closed by sutures. A thick pupillary membrane resulted, and vision remained limited to recognition of motion of the hand close to the eye. To prevent a similar disaster in the right eye, Schneider gave intragluteal injections of 5 cc. of a 2 per cent solution of a styptic lung preparation on the two days preceding the operation, and of 10 cc. on the day it was performed. An injection of scopolamine and

morphine was given one hour prior to the operation and cocaine was used as a local anesthetic. The extraction of the cataract with an iridectomy proceeded without any hemorrhage or other complication, and uneventful recovery followed, yielding vision of 0.9 of the normal.

K. L. STOLL.

LIGHTNING CATARACT: REPORT OF A CASE. V. HILLSCHER, Klin. Monatsbl. f. Augenh. **91:** 610 (Nov.) 1933.

A man, aged 23, was unconscious for one-half hour after having been struck by lightning. He had burns of the first and second degrees on the forehead, the left side of the face, the back and the left thigh. A dark burn over the right scapula marked the probable entrance of the charge. The lids were inflamed and swollen; photophobia existed, and the patient could not see well in bright daylight for about six months. Ataxic gait, which was present on the first day, and bilateral indistinct vision, observed since the tenth day, had improved after three weeks. Recovery was retarded by erysipelas. The general physical condition and the nervous system were normal.

Vision began to fail gradually in both eyes six months after the accident; it was 5/7 of the normal after four more months. The deficiency was due to bilateral subcapsular opacities of the lens, more distinct on the posterior than on the anterior capsule; opalescence was noticed. Three months after the preceding examination vision was reduced to 5/35, and considerable structural changes in the cortex of the lens had taken place. The nuclei remained clear until a few months later, when a discission was done in the right eye, yielding vision of 5/4. No changes were noted in the fundus. A rapidly increasing secondary cataract, however, developed three weeks after the operation, reducing vision to 5/7 of the normal in the right eye; at that time vision was only 1/20 in the left eye. After this examination the patient did not return for consultation.

Hillscher classes these lenticular changes with complicated cataracts, according to Vogt's definition, but he was unable to assign them definitely to one of the three types. The subcapsular arrangement of the opacities and the time consumed in ripening in this case corresponded with the conditions observed in cataract caused by electric shock. In this case and in two other cases cited, the electric shock caused transient functional lesions of the iris and ciliary body; development of cataracts followed, analogous with the reaction of the lens to other exogenous temporary lesions. The diagnosis of cataract due to lightning or electric shock cannot be made by means of the slit lamp only. It is essential to rule out similar exogenous forms of cataract by exact general examination.

K. L. STOLL.

Methods of Examination

INTERFEROMETRY IN THE DIAGNOSIS OF TUBERCULOUS IRIDOCYCLITIS. G. WEILL, Ann. d'ocul. **170:** 913 (Nov.) 1933.

Weill concludes as follows: "We were not able to control our diagnosis of tuberculosis by a pathologic examination. Only one eye was

enucleated, for painful glaucoma after iridocyclitis, which clinically was tuberculous. The patient did not present any other clinical signs of tuberculosis, and microscopic examination of the eye showed chronic diffuse inflammatory lesions, without nodule formation and without discovery of the Koch bacillus.

"In all the cases, the reaction of the skin was positive, but we know that the cutaneous reaction has only relative value. Similar results were obtained with the Mantoux test. From the results given by interferometry, not only in our case of diffuse iridocyclitis, but also in nearly one hundred other observations, which we expect to report later, we estimate that there is assistance to be obtained from it, but care must be taken in its use.

"We use a biologic method that has surmounted numerous objections in physiologic as well as in chemical fields. Like all biologic methods, interferometry is liable to numerous errors, from the point of view of technic as well as of results. The errors can be found and avoided by direct collaboration between the laboratory and the clinic.

S. H. McKee.

Red-Free Ophthalmoscopy and Indirect Illumination of the Retina. W. Thorner, Klin. Monatsbl. f. Augenh. **91:** 461 (Oct.) 1933.

Thorner discusses the methods of red-free ophthalmoscopy and the use of various red-free filters, before describing his own new method. He succeeded in constructing a new arrangement of illumination for his large ophthalmoscope, which yields the same brightness in red-free ophthalmoscopy as Vogt's original method, although a lamp with a metal filament is used. The observations can be made with all the advantages of reflex-free ophthalmoscopy, namely, quick exchange of the ordinary and the red-free light, exchange of the large field and weak illumination for the small field under strong light and exchange of the indirect retinal illumination for stereoscopic examination. The new method, in Thorner's opinion, meets all the requirements for ophthalmoscopic examination. A number of paintings show the details which can be observed in the area of the macula and disk, illustrating the advantages of this new apparatus.

K. L. Stoll.

Perimeter for Localization of Retinal Tears. K. Velhagen Jr., Klin. Monatsbl. f. Augenh. **91:** 583 (Nov.) 1933.

A perimeter has been used for the localization of retinal tears at the eye clinic of Halle, Germany, for four years. This method was improved by the construction of the perimeter which Velhagen describes in detail. It permits examination unhindered by apparatus, can be moved in every direction and is attached on a perpendicular rod which facilitates upward, downward and axial rotation and fixation as soon as the direction has been found. This perimeter is used after the approximate location of the tear has been established. The fundus is examined by the indirect method with the ophthalmoscope which is kept closely to the arc of the perimeter. Directions are given to overcome difficulties of examination in the presence of heterophoria.

K. L. Stoll.

THE PRACTICAL WORTH OF THE COMPLEMENT-FIXATION REACTION TO TUBERCULOSIS IN DISEASES OF THE EYE. W. ROHRSCHNEIDER, Med. Klin. **30**: 120 (Jan. 26) 1934.

Lesions of the eye with a clinical diagnosis of tuberculosis are most often not associated with evidence of pulmonary tuberculosis. If this condition is present the usual tuberculin test should result in a focal exacerbation of the disease. This is difficult to watch and control in ambulatory outpatients. Most grown people have had a tuberculous infection at some time and this has healed. Thus with the Mantoux test 30 per cent of normal persons show a positive reaction. Reactions to the intracutaneous and Pirquet tests show only a cutaneous allergy against tuberculosis. Rohrschneider has tried the method of complement-binding as described in the works of G. Blumenthal. He has examined 275 persons. In 49 the results were positive and in 26 the results were questionable. In 38 patients younger than 20 years of age no positive reactions occurred. Between the ages of 21 and 60 the reactions were as 1 to 3 or 1 to 4; in the more aged the reactions again became fewer. In 46 patients of this group used as controls without evidence of tuberculosis, the test gave a positive result seven times and a questionable result a like number of times. Rohrschneider believes that a negative reaction is indicative of the absence of tuberculosis, but questions what a positive reaction means. Six persons known to have tuberculosis of the eye showed negative reactions. Three of these were under the age of 20 years. He compares his results with those obtained by others using the same or similar methods and concludes that the value of the test remains in question.

L. L. MAYER.

Neurology

OCULAR CHANGES IN PSEUDOSCLEROSIS (KAYSER-FLEISCHER'S RING, DISTURBANCE OF ACCOMMODATION AND PUPILS, PARALYSIS OF UPWARD MOTION OF THE EYES): REPORT OF A CASE. L. HEINE, Klin. Monatsbl. f. Augenh. **91**: 433 (Oct.) 1933.

A woman, aged 45, had had increasing tremor of the head and arms and ataxia of the legs since the eighteenth year of her life. Examination revealed cirrhosis of the liver, an enlarged spleen, irregularity of the blood sugar curve, lymphocytosis of 49 per cent and trophic disturbances of the nails. The Wassermann reaction of the blood was negative. Adiadokokinesis, unsteady gait, staccato speech, difficulty in swallowing, incontinence of the bladder and a condition akin to mask-like face were present. One brother, aged 55, was living; seven brothers and sisters had succumbed in early life to tuberculosis, inflammation of the brain or diseases of the liver or heart. Visual acuity, accommodation, the field of vision and the perception of color were normal. The pupils were moderately enlarged, and reaction to light was absent; convergence was absent. Sensitiveness to light was lowered during artificial mydriasis. The eyes could not be lifted, although ptosis did not exist. The motion of the eyes downward and to either side was normal.

Heine attributes the rigor of the pupils and the inability to look upward, in the absence of ptosis, to syphilitic changes in the corpora

quadrigemina. He quotes Lüthy, Strümpell, Kraupa and other writers in support of his view, and points to the combination of cirrhosis of the liver and cerebral lesions and to the mortality of the other children, which is further illustrated with a family history reported by Jaensch and Jendralski. Kayser-Fleischer's ring occurs in 50 per cent of these cases, according to Hall, but in 25 per cent only, according to Heine.

K. L. Stoll.

Unilateral Choked Disk and Olfactory Disturbance: A Contribution to the Foster-Kennedy Syndrome. Report of a Case. H. Schmelzer, Klin. Monatsbl. f. Augenh. **91**: 479 (Oct.) 1933.

A man, aged 43, had suffered from periodic dull frontal headache and vertigo for two years and from violent vomiting for three weeks prior to observation. He seemed to be healthy, but was apathetic and showed rotatory nystagmus on forced looking to either side. Choked disk, 2 diopters in elevation, was seen in the right eye, and the retinal veins were distended and tortuous. Vision was normal. The blind spot was slightly enlarged, but the field of vision was normal. The intra-ocular tension was equal to that of the left eye, in which a physiologic excavation of 1.5 diopters in depth was noted. Examination after Börnstein's method showed complete anosmia on the left side and hyposmia on the right. A shadow was seen in the roentgenogram of the left olfactory groove. Successful removal of a ganglioglioma of the left frontal lobe verified the diagnosis.

The olfactory sense should be examined in neurologically doubtful cases, especially in the presence of unilateral choked disk.

K. L. Stoll.

Operations

A Little Used but Excellent Method of Approaching the Retrobulbar Space. F. Ody, Schweiz. med. Wchnschr. **64**: 78 (Jan. 27) 1934.

Ody appraises the method of Kronlein and that of Kocher and shows wherein the latter has supplanted the former. The method he prefers is that in which a transfrontal orbital bone flap is made. By means of special retractors the dura is readily held away from the roof of the orbit. The roof is easily removed so that the retrobulbar contents can be viewed. The disadvantage is in the large frontal trepanation, but this is also required in cases of tumor of the hypophysis. The advantages are that a possibly infected sinus is not opened, the dura is readily entered if a cerebral process is involved, and on the other hand the dura is held intact if there are no indications for opening it. Also the ventricular fluid may be removed in order to allow more space for exposure. Removal of a tumor with replacement of orbital contents by this method is much less disfiguring.

Photographs of the approach and of the mechanical retractors accompany the article.

L. L. Mayer.

Orbit, Eyeball and Accessory Sinuses

STEATOSIS BULBI WITH SPECIAL REFERENCE TO THE CORNEA. T. M. SHAPIRA, Am. J. Ophth. **16:** 1080 (Dec.) 1933.

Shapira reviews the literature on fatty degenerative processes occurring in the anterior section of the optic globe. He reports two cases. In the first, following a simple extracapsular extraction of cataract there appeared a fine gray opacity in the upper inner quadrant on the posterior surface of the cornea. Secondary glaucoma developed in the eye, and an iridectomy was done. Examination of the excised iris confirmed the clinical diagnosis of secondary glaucoma due to a downgrowth of epithelium into the anterior chamber. The eye was eventually removed, and examination revealed a new-formed tissue in front of Bowman's membrane, especially in the limbal region. This tissue consisted of fibroblasts with elongated nuclei, between which were occasional lymphocytes. The anterior chamber was filled with exudate, leukocytes and fibrin, and the contents took the fat stain especially well in the angle of the chamber. The iris also contained much fat and was atrophic. Case 2 was that of a boy, aged 15, who had been struck in the right eye with a hammer seven years previously. Examination of this eye revealed superficial and deep vessels running into the cornea from all sides for about 1 mm. Uveal pigment was adherent to the corneal surface posteriorly, and at 6 o'clock a triangular mass pointed toward the corneal center and consisted partly of crystals with hemorrhagic pigment. The x-ray picture revealed a foreign body in the orbit, probably buckshot. The eye was enucleated, and histopathologic examination revealed an anterior chamber filled with lens material, vitreous, leukocytes and fibrin. The fat droplets were very pronounced and were localized at the periphery of this semifluid substance. They were not to be seen at the center of the mass. In conclusion the author discusses (1) the origin of the fat in these processes, (2) the type of fat found, (3) the part played by cholesterol and (4) the origin of the phagocytes in the cornea.

W. S. REESE.

Pharmacology

AN EXPERIMENTAL STUDY OF A NEW MIOTIC (CARBAMINOCHOLINE). M. APPLEMANS, Compt. rend. Soc. de biol. **115:** 1259, 1933.

In living rabbits, the instillation into the conjunctival sac of carbaminocholine hydrochloride in 0.1 per cent solution contracts the pupil. With the use of a 0.0001 per cent solution, a subconjunctival injection is effective in two minutes, and an injection into the anterior chamber produces instantaneous miosis lasting for an hour. The activity of this derivative of choline is extraordinary, but transitory.

J. E. LEBENSOHN.

Physiology

INTRAOCULAR COLOR FILTERS OF VERTEBRATES. C. L. WALLS and H. D. JUDD, Brit. J. Ophth. **178:** 641 (Nov.); 705 (Dec.) 1933.

This work was commenced under an Alfred H. Lloyd Fellowship by the senior author at the University of Michigan and completed during his tenure of the National Research Fellowship.

The oil droplet filter is usually a single large spheroid, occasionally smaller and multiple, in the retinal cone. It is ordinarily red, orange, yellow or rarely greenish yellow, or it may be colorless. As one ascends the vertebrate scale, oil droplets are first found in the sturgeon. The frogs are the most primitive of living vertebrates that are known to have colored oil droplets. Oil droplets are found in most reptiles and birds. Of the mammals the two lower divisions are claimed to have them. Physiologically yellow lenses are found in diurnal snakes, lampreys and squirrels. Yellow corneas are seen in a number of fishes. The human retinal capillaries form an effective filter and absorb much violet and some blue.

The article contains a lengthy analysis of possible interpretations of such filters, which may be summarized largely in the authors' words as follows: Any color filter is worse than useless in scotopic vision. Natural yellow filters in general, including all yellow and orange oil droplets whether found alone or combined with red ones, have a quadruple beneficial effect on photopic vision under average outdoor conditions. They do not help to *endow* the animals with color vision—they *modify* it. They are not designed to equalize the actinic power of wavelengths, nor do they protect the visual cell outer segments from ultraviolet light. None of the pigments concerned can be considered photochemical substances comparable with visual purple, etc.

Red oil droplets perform, incidentally, most of the functions of yellow filters, even better than the latter when the objective light intensity is very high, but introduce an undesirable curtailment of the subjective chromatic spectrum and become inefficient in "comfortable" illuminations except when the amount of scattered medium-wave light is great, as at the twilight periods. For these reasons they are never found alone, but always accompanied by large numbers of paler droplets which bear the brunt of the work of vision under ordinary conditions. The primary importance of red droplets, in birds, is in sharpening vision in the reddened illumination (with its accompaniment of scattered violet, blue and green light) of their favorite matutinal period of great activity. In turtles (and the kingfisher?) their primary function is to reduce the excessive glare which interferes with sharp vision under water.

Diurnal vertebrates that rely on lenticular, corneal, macular and capillary filters choose of necessity a single optimum color and density and accept a resultant limitation of those activities in which their visual capacities are important. The oil droplet type of filter, however, permits the development of a functionally multiplex photopic apparatus, with a resultant wider range of adaptation to varying illumination. Because many cones would not be maximally efficient under any one static set of conditions, only retinas very rich in cones can afford to evolve a multiple oil droplet mosaic—and it is in such retinas that the multiple system finds its highest expression.

One may tentatively interpret the macular pigment as a local deposit of carotenoid allowed to accumulate to serve a special purpose. It is perhaps significant that the pigment is rarely present at birth.

W. ZENTMAYER.

THE INFLUENCE OF TONUS ON REFRACTION AND VISUAL PHENOMENA. K. GOLDSTEIN and W. JABLONSKI, Arch. f. Ophth. **130:** 395 (Sept.) 1933.

A woman, 20 years of age, presented meningitis serosa in the left posterior fossa following acute otitis externa and media. The lesion of the left vestibular nerve and of parts of the left cerebellum produced a disturbance of the equilibrium which the patient overcame by tilting her head toward the right shoulder. If the head was not held in that position the patient immediately experienced severe vertigo and nausea. With the head in that new "normal" or preferred position the patient acted better in many ways than when the head was in the straight position. The patient's right eye had an objective refractive error of +0.75 cylinder axis 90. With the head in the preferred position the visual acuity was normal without glasses; with the head in the straight position, it dropped to 20/40 with a —6 lens. Under atropine and with a pinhole, the right eye had normal vision when the head was in the preferred position and 4/60 when it was in the straight position. In the straight position of the head, therefore, a spasm of accommodation and a reduction of visual acuity prevailed which could not be accounted for by the refractive error. To explain the latter phenomenon the authors performed a series of experiments which revealed a striking functional inferiority of the eyes in the straight position of the head as compared with the preferred position, namely, increased differential thresholds on several sensory fields, an increased minimum visible, marked distortion of all visual objects, macropsia and micrographia (the latter with and without the minus lens). Red light made the visual functions worse in every respect; it even produced a spasm of accommodation in the preferred position of the head. All these phenomena are interpreted as effects of the tonus anomaly on the central and peripheral visual apparatus.

P. C. KRONFELD.

HISTOCHEMISTRY OF THE CORNEA. Y. SUGITA, Arch. f. Ophth. **130:** 488 (Sept.) 1933.

Frozen sections of the cornea of rabbits, stained with a solution of methylthionine chloride U. S. P. (methylene blue), showed a pronounced metachromatic effect. The lamellae of the stroma stained violet-blue while the protoplasma of the epithelial cells showed a very light blue. With the "universal indicator" of Merck the p_H in the epithelial layer was found to be between 7 and 6.5 and that of the stroma between 8 and 9. The aforementioned metachromatic effect could also be demonstrated by injection of the stain in vivo.

P. C. KRONFELD.

INCREASED SENSITIVITY TO LIGHT PRODUCED BY PREVIOUS LIGHT STIMULI. S. W. KRAVKOV and E. N. SEMENOVSKAJA, Arch. f. Ophth. **130:** 513 (Sept.) 1933.

The paper deals with the phenomenon previously described by Aubert, Piper and Nagel that the progress of dark-adaptation is favored by the effect of a short appreciable extra light stimulus. The authors studied it quantitatively with the adaptometer of Nagel. The pre-

exposure took place in a small room with white walls and a light intensity of approximately 10 luces for fifty minutes. Then the extra stimulus was applied (for instance, 220 luces during one and five-tenths minutes). Immediately afterward the process of dark-adaptation was studied. It was found that the extra stimulus altered the adaptation curve in a very characteristic way, as compared with that observed in other experiments with the same preexposure but no extra stimulus. The extra stimulus retarded the progress of dark-adaptation slightly during the first forty minutes, but accelerated and raised it to an abnormally high level later on. This phenomenon also took place if only one eye received the extra stimulus and its mate's dark-adaptation was determined. The direct effect, however, was stronger than the indirect effect. The whole phenomenon apparently is central in origin and antagonistic to the effect of extra stimuli on the peripheral visual apparatus.

P. C. KRONFELD.

Refraction and Accommodation

VERY HIGH ASTIGMATISM IN KERATOCONUS AND POST-CATARACT CASES. B. Y. ALVIS and M. WIENER, Am. J. Ophth. **16:** 981 (Nov.) 1933.

The authors review some of the reported cases of high astigmatism and report five cases of keratoconus and two cases of cataract all of which exhibited high astigmatism. They conclude that no definite limit can be set to the strength of the lens required so long as vision is improved and that the fitting of these lenses requires persistent cooperation between the patient and the examiner.

W. S. REESE.

CHANGES IN REFRACTION WITH HYPERGLYCEMIA. R. N. BERKE, Am. J. Ophth. **16:** 1087 (Dec.) 1933.

Berke reviews the literature on changes in refraction in accompanying diabetes. A case is reported of a man, aged 38, whose eyes on refraction in April 1932 had shown a hyperopic error. Six months later he returned, complaining of blurred vision, and stating that four or five days previously he could not see clearly beyond 6 feet (1.8 meters), the next day not beyond 3 or 4 feet, and on the day of examination not beyond arm's length. He also stated that he had lost a "lot of weight" and was drinking from 4 to 6 quarts (3,785 to 5,675 cc.) of water daily. Reexamination showed that he had become myopic, there being a change of 2 diopters in his refraction. He was put on insulin, and stated that after the first injection his vision became normal. Following discharge from the hospital he was found to be hyperopic. The following conclusions are made: "1. Transitory changes in refraction, myopic or hyperopic, occur in diabetes mellitus. 2. Myopic changes occur with increasing sugar concentration in the blood and hyperopic changes with decreasing blood sugar. 3. Myopic refractive changes call for immediate diabetic treatment because of the bad prognosis associated with these cases, one third of all reported cases having died. 4. Moderate doses of atropin or hematropin have no immediate effect on the myopia of diabetes."

W. S. REESE.

BINOCULAR UNEQUAL ACCOMMODATION. R. GRIMM, Arch. f. Ophth. **131:** 127 (Oct.) 1933.

Carl von Hess denied the possibility of unequal accommodation of the two eyes. His view was mainly based on the following experiment: An isometropic pair of eyes is made anisometropic by adding a + 1 lens to the proper correction of one eye. Fine print, seen at the usual reading distance, still seems perfectly clear. A fine needle held 1 cm. in front of the print appears in double images which to von Hess and his co-workers looked unequal in distinctness. Therefore von Hess concluded that the artificial anisometropia of 1 diopter could not be overcome by unequal accommodation. The absence of any visible blurring of the print he explained as the result of antagonism between the two dissimilar images.

On repeating the aforementioned experiment on himself Grimm found no difference between the double images of the needle held in front of the fixated print. Furthermore, he was certain that the distinctness of the print was the result of fusion and not of antagonism. He was able to overcome a difference in refraction of 1.5 diopters. The unequal accommodation set in shortly after the fixation in the state of artificial anisometropia had begun and disappeared soon after the fixation had ceased.

To make the experiment more conclusive he studied the fusion of two partly identical and partly different fine targets in the state of artificial anisometropia. Thus he convinced himself that he fused the two targets perfectly, which necessitated unequal accommodation. In another series of experiments he made his eyes isometropic and set one of the aforementioned targets farther away from the eyes than the other (for instance, 26.8 cm. from the right and 33.45 cm. from the left eye). Again perfect fusion was accomplished. The size of the fused image appeared to be the mean of the monocular images.

The rest of the paper contains a discussion of accommodation as an optopsychic reflex, i. e., an involuntary reflex action whose nervous path goes through the cortex.

P. C. KRONFELD.

Retina and Optic Nerve

DETACHMENT OF THE RETINA—ITS PRESENT OPERATIVE TREATMENT. D. K. PISCHEL, Am. J. Ophth. **16:** 1091 (Dec.) 1933.

Pischel describes the different types of operation used for retinal detachment. He discusses their advantages and disadvantages mainly from the standpoint of personal observation of the technics of the originators of these operations. Fifteen cases are reported and the following conclusions made: "The Safar operation seems to be the best one for treating detachment of the retina, because of the following advantages: ultra-accurate localization is not necessary; several holes or large areas can be treated in one operation; drainage goes out through many small openings; the retina is kept away from the choroid during the whole of the operation so that it is protected from trauma; there is no possibility of intraocular hemorrhage; any part of the eyeball can be reached; the technic is fairly simple; it is not time consuming."

W. E. REESE.

TECHNIC OF THE METHOD OF DIATHERMY FOR THE TREATMENT OF RETINAL DETACHMENT. H. WEVE, Ann. d'ocul. **171**: 1 (Jan.) 1934.

The article begins with an introduction followed by general considerations, treats of anesthesia, the importance of its being good, the localization of the hole, the operation, the diathermic apparatus and the technic of operation, offers some remarks on the causes of failure, and concludes with a summary as follows:

The essential feature of the technic described is the employment of diathermy on the tear after the principle of Gonin, in the gentlest possible manner. It is indispensable to have the localization absolutely exact, with the ophthalmoscope in hand for use, and to employ very short, fine electrodes (from 0.5 to 0.75 mm. in diameter) and a weak current (not more than 50 milliamperes with perforating electrodes).

The advantages are: the numerous indications, a large percentage of cures and practically no complications (Weve has encountered only three serious hemorrhages in more than two hundred and fifty cases). Fixation of the displaced retina and irradiation of the cicatrices have not been observed. He has never observed cataracts in those who have been operated on and cured.

S. H. McKEE.

FAT EMBOLISM OF THE EYE. J. URBANEK, Arch. f. Ophth. **131**: 147 (Nov.) 1933.

Urbanek quotes Leber's introduction to his chapter, "Peculiar Types of Embolism of the Central Artery," in the Graefe-Saemisch handbook: "It is well known that after severe injuries, especialy after complicated fractures, fat enters the blood stream not infrequently; there it circulates in smaller or bigger drops and can lead to obstructions of small arteries or capillaries. The destroyed bone marrow and fat tissue furnishes the material for these emboli. If the patient survives the emboli in the pulmonary arteries he is not likely to develop complications on the part of other organs. No case has ever been observed in which visual disturbances were shown to be caused by fat emboli in the retina." Urbanek then reports seven cases of posttraumatic fat emboli in the retina in which it was possible to make the diagnosis ophthalmoscopically. In three of the cases the eyes were subjected to pathologic examination.

The general course was usually as follows: After a severe trauma the patient was brought to the surgical clinic with fractures of one or several bones. Shortly after adjustment of the broken limb and application of the cast, the patient presented slight fever, cyanosis of the fingers, lips and nose, and very superficial respiration, and usually became irrational. One patient, after he regained consciousness, complained of a visual disturbance, which aroused the interest of the surgeon in the ophthalmoscopic findings. In the other cases there were no subjective complaints concerning the eyes. The ophthalmoscopic picture was that of a hemorrhagic retinitis. White lesions, usually located

at the branching places of vessels, and striated retinal hemorrhages became visible, persisted for from four to six days, and disappeared. New lesions occurred at new places, taking the same course. The hemorrhages were usually the first finding. Shortly afterward, near the edge of the hemorrhages, the white lesions became noticeable. The whole process took several weeks if the patient survived the initial pulmonary emboli.

The eyes that were available for pathologic studies were sectioned and stained with osmium or scarlet red. The former was found to give a better idea of the extent to which fat was present in the ocular vessels. Fat was demonstrated in the capillaries of all the tunics of the eye. The choroid and retina in the region of the posterior pole were relatively more affected than any other part. The anterior segments were much less involved. The white lesions in the retina which had been seen ophthalmoscopically showed edema of the nerve fiber and ganglion cell layer. No free fat or necroses could be found anywhere in the tissues of the eye.

In only one patient did permanent damage result (a disturbance of pigment in the macula and partial optic atrophy). Urbanek therefore believes that the fat emboli lead usually only to temporary obstruction of capillaries. He compares his ophthalmoscopic pictures with that of Purtscher's lymphorrhagia retinae and comes to the conclusion that the two conditions are identical and have most likely the same pathologic mechanism.

P. C. KRONFELD.

GONIN OR WEVE? EXPERIENCES WITH THE OPERATIVE TREATMENT OF DETACHMENT OF THE RETINA. E. ENGELKING, Klin. Monatsbl. f. Augenh. **91**: 289 (Sept.) 1933.

The author discusses his experience with Gonin's method and the treatment by diathermy after Weve in fifty-six cases. Tables show the results obtained by these methods on twenty eyes operated on during the first eight months of 1932; of these, ten eyes were healed after eighteen operations, while no results were obtained by seventeen operations in the remaining ten eyes. Weve's method, in Engelking's opinion, promises better results than ignipuncture and seems to be quite as effective as the more complicated methods of Lindner and Guist. The author considers the conservative treatment of detachment of the retina as obsolete and demands that cases be referred at once to the oculists practicing the divers methods by those who are not equipped to do so.

K. L. STOLL.

THE GENESIS OF DETACHMENT OF THE RETINA. M. BARTELS, Klin. Monatsbl. f. Augenh. **91**: 437 (Oct.) 1933.

Bartels reports two cases of recent bulla-shaped detachment of the retina with a large tear, one in a woman, aged 55, the other in a man, aged 38. Inside the large tears a tightly extended fine membrane was visible; it represented the external leaf of the retina, which was split

lengthwise along the internuclear layer. The internal leaf, facing the vitreous, was the portion of the retina detached from the ora serrata; it was folded at the margin of the large tears. Remnants of Henle's fibers adhered to both leaves. Very fine tears, two in the woman's and four in the man's case, were noticed in the fine membrane; all of them had lips turned toward the vitreous, and only through these fine tears could the red color of the choroid be seen. Neither Leber nor Arruga refer to similar conditions, probably because they are observed only in cases of recent detachment. The mechanism of the splitting of the retina into two leaves is explained histologically, and comparisons are made with two cases described by Redslob and Sourdille and considered by Bartels to be the result of cystoid degeneration of the retina.

Discussing the origin of the fluid in the cysts, Bartels states his reasons for believing (1) that it is produced by the retina, which is primarily diseased, (2) that cystoid degeneration is an edema which produces the splitting, (3) that the small tears allow a connection between the vitreous and the subretinal fluid, and (4) that detachment of the retina is due to primary disease of the retina.

A tear is not essential for the formation of a detachment, as no tear could be found clinically or in serial sections in Redslob's case.

K. L. STOLL.

ANGIOMATOSIS OF THE RETINA; RESULTS AND CONCLUSIONS. P. JUNIUS, Klin. Monatsbl. f. Augenh. **91:747** (Dec.) 1933.

Junius gives a synopsis of the literature on angiomatosis of the retina, discusses each case briefly and attempts to compose some contradictory views. These publications prove the existence of two types of retinal changes in this disease: Either there is a predominance of newly formed vessels or there is a proliferation of cells resembling a tumor. Angiomatosis of the retina may remain benign up to an advanced age. In many of the patients the blood supply of the retina is disturbed as the result of a subnormal development or lack of the capillary net of at least a portion of the retina. Owing to malformations of the vascular system vascular convolutions analogous to those in the retina occur in the cerebellum and cerebrum: A normal capillary net was absent in Dandy's patient, and a persistent vena capitis lateralis was present in a patient of Yates and Paine, both conditions apparently representing embryonal malformation. The fundamental condition for the development of angiomatosis of the retina, in some cases at least, seems to be a congenital absence of blood vessels in one or several areas of the retina. The compensatory impulse of the organism results in the preservation of embryonal blood vessels which normally disappear and the formation of neoplasms.

Histologic examination reveals the occurrence of numerous capillaries with the lumen filled with endothelial cells. In the retina the fundamental factor is the angiomatosis, no matter what secondary development may result.

Junius accepts Roussy's and Oberling's division of the angiomatous tumors into three types: (1) cavernous tumors (the hemangiomas

of Cushing and Bailey), which occur in all parts of the brain, (2) angiomas of the reticulo-endothelial type (the hemangioblastomas of Cushing and Bailey) and (3) angiogliomas (the intercolumnar hemangioblastomas of Cushing and Bailey). The tumors of the second type, of interest in this connection, have been found in the central nervous system and in the retina. They are formed, not by simple vascular epithelium as are the ordinary angiomas, but by reticulo-endothelial tissues. Secondary changes may entirely transform their structure. Stasis of the lymph may lead to lipolipoid transformation of the cells, and xanthomatous transformation of the reticulum may result. Berger and Vallée reported a case of angioreticuloxanthoma of the retina.

Several problems remained unsolved. Junius could not explain why Viets' patient experienced no discomfort from the changes in the cerebellum and from angiomatosis of the retina, which had existed for several decades, but suffered an exacerbation only in his eye when he was 44 years of age. Equally uncertain remained the etiology of the development of vascular convolutions in the retina and the brain.

K. L. Stoll.

Tumors

A Case of Melanotic Sarcoma of the Iris. S. J. Meyer and D. J. Kubik, Am. J. Ophth. **16:** 893 (Oct.) 1933.

The authors cite the case of a 54 year old man in whom a tumor of the upper half of the iris of the left eye was discovered during refraction. The eye was highly myopic, and the episcleral veins in the upper half of the globe were markedly dilated and tortuous. The posterior surface of the cornea was covered with fine pigment. As enucleation was refused, the tumor was removed by iridectomy. Secondary glaucoma eventually developed, and the eye was removed, but the patient died several months later from metastasis. Autopsy was not secured, but the pathologic changes in the enucleated eye are described. The authors state that one should designate a tumor of the iris as unconditionally malignant when the dissemination of pigment in the anterior chamber is present after a short time.

W. S. Reese.

Four Observations of Sympathoma of the Suprarenal Capsule with Ocular Symptoms. Van der Straeten and Maldague, Arch. d'opht. **50:** 513 (Aug.) 1933.

The authors describe four cases in which sympathoma of the suprarenal capsule was diagnosed clinically and the diagnosis confirmed by autopsy in one case and by biopsy in the other three. It is a condition still thought to be rare; the knowledge and individualization of it are relatively recent. Masson believes the rarity to be the result of a failure to recognize the cases clinically. Three of the cases presented were observed in the course of a few months. The observations thus far published have been so similar that it has been possible to establish a disease entity the diagnosis of which can generally be made with probability of correctness clinically. Histologic examination is essential for

verification. After briefly calling attention to the literature the authors systematically discuss the symptoms, etiology, diagnosis, pathology, prognosis and treatment of the condition. As the disease begins in the abdomen it seems that the first symptom should appear in this region. In some cases abdominal pain has been the earliest indication, but as a rule the pain does not point to a lesion of the suprarenal gland. It is the metastases which usually first draw attention to the possible presence of this growth. When metastases are discovered, a careful abdominal examination, sometimes under general anesthesia, will decide the diagnosis. The metastases occur in the liver, the abdominal and general lymph nodes and the bones, especially those of the skull, and in an almost elective manner in the bones of the orbit. Those in the skull produce irregularities in its surface and are of special interest to the ophthalmologist because of the ensuing ocular symptoms. The first of these is exophthalmos, the eye being pushed straight forward or to one side. As this progresses secondary symptoms appear. Choked disk may be observed owing to the rise in intracranial pressure as the result of the metastases in the skull. Ecchymotic discoloration of the lids is an early sign of the development of metastases of great malignancy. Epistaxis and bleeding ulcers of the nares have been noted. The general symptoms include pallor, anemia, apathy, etc. Biopsy should confirm the clinical diagnosis and should be done as recommended by Maldague on a metastasis in the skull, where the analogous typical structure of the tumor is most marked. The prognosis is bad. In few cases can surgical intervention be undertaken with hope of success. The tumors are radiosensitive but recur fatally.

S. B. MARLOW.

MELANOSARCOMA OF THE OPTIC DISK. T. OGUCHI, Arch. f. Ophth. **130:** 427 (Sept.) 1933.

The author describes a melanosarcoma in a man, 21 years of age. The anterior segment and the fundus were normal except for the dark brown tumor which, 2 by 4 mm. in size, covered the disk completely (one beautiful drawing in colors). The corrected vision was 0.5; the field contracted down to the 20 degree circle. The eye was removed immediately. The tumor was found to be heavily pigmented. Bleached sections revealed the cells to be of mixed type. The tumor had no connection with the choroid but extended somewhat into the optic nerve. It apparently was the primary tumor. The author mentions the frequent occurrence of "physiologic" melanosis papillae among the Japanese. His case is only the third of melanosarcoma of the disk in which a pathologic examination was made and the result published.

P. C. KRONFELD.

EPIBULBAR HAMARTOMA IN A CASE OF HYDROPHTHALMOS. C. OGUCHI, Arch. f. Ophth. **130:** 432 (Sept.) 1933.

An almost blind hydrophthalmic eye was enucleated. In addition to the usual changes it showed, adherent to the temporal portion of the sclera, a piece of tissue which consisted of cavernous vessels, striated

muscle, fat and connective tissue, but which was not blastomatous. The author calls it a hamartoma, a name which was first used by the pathologist E. Albrecht for abnormal mixtures of normal tissues.

P. C. KRONFELD.

CLINICAL SYMPTOMS, PATHOLOGY AND THERAPY OF EPIBULBAR CARCINOMA ARISING FROM PAVEMENT EPITHELIUM. F. V. PAPOLCZY, Arch. f. Ophth. **131**: 32 (Oct.) 1933.

The paper is based on forty-three cases of epibulbar carcinoma seen at the first eye clinic of the Royal Hungarian University in Budapest during the last twenty-five years. During this period the frequency of this type of carcinoma was only one-fifth that of uveal sarcoma. Papolczy divided his cases into four groups, namely: (1) those in which the tumor did not recur after its removal from the globe; (2) those in which the tumor recurred several times but after repeated attempts at its removal from the globe finally failed to recur; (3) those in which after several recurrences enucleation or exenteration of the orbit became necessary, and (4) those in which, because of the size and extension of the tumor, immediate enucleation or exenteration was performed.

Papolczy confirmed the well known fact that the limbus, especially its temporal and nasal quadrants, is the favored place of origin for epibulbar carcinoma. It is therefore possible that exposure to external stimuli is one of the causes of the carcinoma. A definite relation was found between the occurrence of pterygium and that of the carcinoma. The most frequent age of occurrence is the sixth decade; it is rare in persons under 40. The clinical picture in the early stages is that of a gray nodule with a smooth translucent surface and very marked vascularization, but without irritation of the eye. The histologic picture in the earliest stages is that of a thickened polymorphic epithelium with frequent mitoses, slight leukocytic infiltration and very fine blood vessels. The adjacent connective tissue is infiltrated by small round cells and forms a moderate amount of granulation tissue. Several authors have spoken of an anatomically benign hyperplasia of the epithelium in this early stage, but the recurrences of the tumor after its removal have convinced them of the malignant character of the growth.

In the later stages the epithelium forms finger-shaped processes which invade the deeper layers of the conjunctiva. The sclera and cornea resist further progression of the tumor for a while. Then leukocytes creep between the lamellae of the cornea and the sclera, producing the picture of a superficial keratitis. The leukocytes are followed by the carcinomatous infiltration. Thus the globe is invaded along the route which the inflammatory cells have taken and not through the preformed anterior emissaria.

The removal of the tumor from the globe is carried out without any unnecessary manipulation. The anesthetic is injected under healthy portions of the conjunctiva. From 1.5 to 2 mm. of normal conjunctiva is excised with the tumor, and the exposed parts of the limbus, cornea and sclera are cauterized. Treatment with radiation alone has failed to effect a cure of epibulbar carcinoma.

P. C. KRONFELD.

AN UNUSUAL CASE OF GLIOMA OF THE RETINA. S. MAKIUCHI, Acta soc. ophth. jap. **38**: 5 (Jan.) 1934.

A girl, aged 19, noted in her tenth year that the left eye was blind and that a yellowish-white reflex was present in the pupil. Two years later a tumor developed at the external limbic margin with glaucomatous symptoms and gradually became as large as a hen's egg, separating the eyelids. In July 1933 the tumor suddenly took on rapid growth and caused severe headache and ocular pains. The preauricular and submaxillary glands were not involved, and there were no signs of metastases. The orbit was exenterated. Five months later no recurrence had been observed.

The tumor included the head of the optic nerve where there was no infiltration with tumor cells. The sclera was thickened and formed the posterior wall of the tumor. The growth presented a uniform structure, consisting of bands of cells composed of rosettes and necrotic foci; the rosettes were surrounded by vascular connective tissue. The histologic structure suggested the diagnosis of glioma of the retina. It is unusual for seven years to have elapsed in this third stage.

A. KNAPP.

Uvea

THE DIAGNOSTIC VALUE OF THE EHRLICH-TÜRK LINE IN BEGINNING IRITIS. I. ISAKOWITZ, Klin. Monatsbl. f. Augenh. **91**: 517 (Oct.) 1933.

The genesis of Ehrlich's fluorescein line on the inner surface of the cornea was explained by Türk as the result of the current of aqueous humor produced by varying degrees of warmth. It is a fine perpendicular line extending from about the center of the cornea to the angle of the anterior chamber, and appears dark against the red reflex of the fundus. Isakowitz considers it a decided early symptom in iridocyclitis which appears prior to any other distinct symptom. It may not be present for more than twenty-four hours, that is, as long as the normal warmth of the current still exists in the anterior chamber. The increase of cell elements in the anterior chamber, which settle on all of its walls, will hide the fine line. He thinks that the line is present in 50 per cent of patients suffering from iritis, either as an early symptom or as a late symptom prior to recovery. He observed it also in tuberculous choroiditis and in the beginning iritis that complicates scleritis. Its presence is a signal for immediate use of atropine.

K. L. STOLL.

SPONTANEOUS HEALING IN DETACHMENT OF THE CHOROID OF UNUSUALLY LONG STANDING FOLLOWING TREPHINING AFTER ELLIOT'S METHOD. W. TILLMANN, Klin. Monatsbl. f. Augenh. **91**: 528 (Oct.) 1933.

The prognosis of postoperative detachment of the choroid of long standing is usually unfavorable. To the small number of cases of this type in which cure was obtained Tillmann adds one, which occurred in

a man, aged 67, with arteriosclerosis. The detachment of the choroid was noticed immediately following trephining after Elliot's method, and lasted for one hundred and fifty days. Reattachment, lasting eighty-five days, was followed by a second detachment, which healed spontaneously within fifty-seven days, in October 1932. After that the choroid remained in site. The function of the eye and the field of vision were normal, and vision was 6/10 of the normal in September 1933.

K. L. STOLL.

DISSEMINATED TUBERCULOUS CHORIORETINITIS. Y. ABE, Acta soc. ophth. jap. **38:** 4 (Jan.) 1934.

Two men, aged 22 and 28, had chorioretinitis in one eye and recurring retinal hemorrhages in the other. The atrophic areas in the choroid were of importance, as they could be recognized as tuberculous with the ophthalmoscope, owing to the presence of well pronounced periphlebitis. Furthermore, nearly all of the choroidal foci were grouped principally along the branches of the central retinal vein avoiding the retinal arterial branches. This observation is instructive, as it suggests that the choroidal foci are secondary to the periphlebitic processes.

Abe thinks that disseminated choroiditis may be divided into two types: one, which is more frequent, in which the atrophic areas are distributed irregularly throughout the eyeground and one in which the atrophic areas occur secondary to tuberculous changes in the retinal vessels.

A. KNAPP.

Therapeutics

THE USE OF CALCIUM GLUCONATE IN DISEASES OF THE EYE. G. D. THEOBALD, Am. J. Ophth. **16:** 975 (Nov.) 1933.

The author refers to the efficacy of calcium as a nonspecific remedy and also to some of its more specific uses. She calls attention to the advantages of calcium gluconate, namely, that it is tasteless, is nonirritating to the intestinal tract and when used subcutaneously does not irritate the tissues. It is also less toxic than the chloride. The literature on calcium therapy is reviewed, and the following conclusions are drawn: "In the treatment of inflammatory diseases of the eye, the administration of calcium salts, especially calcium gluconate intramuscularly, 1. Quickly ameliorates pain; 2. Hastens the absorption of exudates from the anterior chamber and vitreous; 3. Favors prompt response of the pupil to atropine; 4. Shortens the course of the inflammatory process. It should be used in conjunction with other recognized measures, such as local treatment, specific general remedies, and the elimination of focal infections."

W. S. REESE.

Society Transactions

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W. GUERNSEY FREY JR., M.D., *Secretary*

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WEBB W. WEEKS, M.D., *Chairman*

MICRO-ANATOMY OF THE EYE WITH THE SLIT LAMP AND CORNEAL MICROSCOPE: COMPARATIVE ANATOMY OF THE ANGLE OF THE ANTERIOR CHAMBER IN LIVING AND DEAD EYES OF MAMMALIA. DR. M. URIBE TRONCOSO and DR. RAMON CASTROVIEJO.

We have used the slit lamp and corneal microscope for the anatomic investigation of the angle of the anterior chamber in mammalia. A more comprehensive idea of the architecture of the angle is gained by observing the angle structures from in front under high magnification of the slit lamp than by the ordinary method of reconstruction from serial histologic sections. We have used dry preparations and wet preparations under water in square jars of optically perfect thin glass.

Minute descriptions are given of the angle of the anterior chamber of the following mammalia:

Herbivora: pig, rabbit and sheep.

Carnivora: dog and cat.

Primates: rhesus monkey, chimpanzee and man.

In the first two groups there is a cleft between the ciliary body and the scleral wall which was called "Fontana's canal" by the earlier anatomists. We propose for this cleft the name "ciliosclerâl sinus."

In herbivora, at the upper part of the ciliosclerâl sinus, the root of the iris is attached to the sclera by filaments which were called the "pectinate ligament" by Hueck on account of their resemblance to the teeth of a comb. The first two rows of teeth of the pectinate ligament are almost horizontal and have been called the "suspensory ligament or pillars of the iris." There is another set of longitudinal strands which runs forward from the insertion of the ciliary body to the sclera and attaches itself to Descemet's membrane. We believe this bundle to be a check ligament of the ciliary muscle, the principal insertion of which is in the sclera at the level of the apex of the sinus. The ciliary body is divided into two parts: the detached or iritic portion, and the attached portion.

In carnivora the arrangement is somewhat different; the strands of the pectinate ligament are less thin and disposed in a vertical direction. The first two rows of these fibers are stronger and give support to the root of the iris. Below them the sinus is filled with innumerable, fine, white threads having a meridional arrangement. There is also a third

bundle of longitudinal fibers, acting, as in herbivora, as a check ligament to the muscle. The ciliary body has the same arrangement as in herbivora. The depth of the cilioscleral sinus bears direct relationship to the capacity of the anterior chamber, which is very large in lower mammalia. Inside the scleral wall of the sinus there is a venous plexus which is known as "Schlemm's venous plexus." This plexus is more developed in carnivora than in herbivora, and it has been mistaken for Schlemm's canal, which is an entirely different structure. To avoid confusion, it is better to call it the "intrascleral venous plexus." There is, properly speaking, no Schlemm canal in lower mammalia, but only venous branches at different heights in the sinus, and at different distances from the inner scleral surface. The ciliary body has also numerous vessels very near the sinus to promote the absorption of the aqueous.

In primates the construction of the angle is quite different. Instead of having two portions—detached and attached—the ciliary body has grown with the development of the ciliary muscle into a strong, triangular structure, which is inserted by a strong tendon into the scleral spur or ring. A new structure appears in primates, namely, Schlemm's canal. While in herbivora and carnivora there is only a more or less compact venous plexus inside the sclera, in monkeys there is a groove between the sclera and the cornea, just above the insertion of the ciliary body. This is an anatomic landmark and can be found in any section, while the intrascleral venous plexus in lower mammalia may occur at different places. In the rhesus monkey and chimpanzee, the root of the iris is still suspended by the fibers of the pectinate ligament, and there is still a small sinus between the root of the iris and the sclera. In man the root of the iris is strongly attached to the anterior border of the ciliary body, and there is no need of a suspensory ligament, but the fibers of the pectinate ligament still are visible in a rudimentary condition, especially in a frontal view of the angle with the slit lamp. Outside the fibers of the pectinate ligament there is a new tissue in man and in the monkey, a meshwork of fibers that closes the open side of the sclerocorneal groove. This meshwork is the trabeculum, a name accepted by almost all authors for a structure which comprises two portions, sclerocorneal and uveal.

INFLUENCE OF FIXATION ON THE VISUAL ACUITY. DR. FRANCIS H. ADLER.

This article will be published in full with the discussion in a later issue of the ARCHIVES.

ANISEIKONIA: 1. DIFFERENCES IN SIZE AND SHAPE OF OCULAR IMAGES. MR. JULIUS NEUMUELLER.

This article will be published in full with the discussion in a later issue of the ARCHIVES.

ANISEIKONIA: 2. EXAMINATION AND CORRECTION OF ANISEIKONIA. MR. LEO F. MADIGAN.

This article will be published in full with the discussion in a later issue of the ARCHIVES.

GUERNSEY FREY, M.D., *Secretary*

May 21, 1934

WEBB W. WEEKS, M.D., *Chairman*

SYMPATHETIC OPHTHALMIA FOLLOWING A SUBCONJUNCTIVAL RUPTURE OF THE EXCITING EYE. DR. FRANK C. KEIL.

A man, aged 30, during a fist fight, had been struck in his right eye, which showed a subconjunctival rupture of the globe with a traumatic coloboma of the iris and a dislocated lens, and vision limited to uncertain perception of light. The left eye was normal, with vision of 20/40 uncorrected. The patient refused enucleation. Five weeks later the left eye showed ciliary injection, precipitates on Descemet's membrane and nodes on the pupillary margin, with visual acuity of 20/200. The right eye was then enucleated. With intramuscular injections of milk, intravenous injections of typhoid vaccine and 125 grains (8 Gm.) of acetylsalicylic acid a day, the left eye improved. At the end of four weeks the patient was discharged with vision of 20/40, corrected to 20/20 with a lens. At the end of six months the eye remains quiet.

Microscopic examination of the enucleated eye showed intense lymphocytic infiltration in the ciliary body which could be followed into the retina and choroid posteriorly to the optic nerve. Only a few nests of epithelioid cells could be seen. An occasional giant cell was found.

DISCUSSION

DR. L. W. CRIGLER: The radical steps taken in this case followed by so complete a recovery mean one of two things: Either it was not sympathetic ophthalmia, or the treatment outlined suggests the possibility of a step in the right direction. If this is a case of sympathetic disease, it is the only one I have ever seen in which the progress toward recovery was uninterrupted and complete.

To those who might be prone to criticize the removal of the exciting eye, let it be known that the eye was soft, painful and totally blind.

OPERATION OF THE LEVATOR MUSCLE THROUGH INCISIONS OF THE SKIN. DR. DANIEL B. KIRBY.

Dr. Kirby presented two cases:

1. A case of ptosis in which the levator fibers were tucked, and the muscle tuck was attached to the skin to produce a crease. Good elevation of the lid was secured.

2. A case of hyperthyroidism with exophthalmos and retraction of the lids which persisted after thyroidectomy. A 3 mm. strip of levator and smooth muscle was removed, and the muscle fibers to the skin were severed. The improvement in appearance and the protection of the eyeball were satisfactory.

DISCUSSION

DR. ISADORE GOLDSTEIN: Dr. Kirby's patient illustrates an excellent result obtained by doing a myectomy of the levator for lagophthalmos in exophthalmic goiter. This principle and that of recession of the

levator are practically the same. In a series of cases in each of which I did a recession of the levator there was one patient who had a papilledema with 5/200 vision. After a period of eight months vision returned to 20/100. This brings up the point whether the Naffziger-Jones operation is indicated in all cases of papilledema. The ideal result is obtained by receding the levator and at the same time performing the Wheeler tarsorrhaphy. This combined technic gives the best cosmetic result.

MELANOMA OF THE CONJUNCTIVA—FATAL TERMINATION. DR. JAMES W. SMITH.

A final report was submitted on a patient presented preoperatively before this section in November 1930 with a clinical diagnosis of recurrent pigmented nevus of the right bulbar conjunctiva. The patient was operated on originally in May 1926. The pathologic report at that time was: cellular nevus. The laboratory report of the section removed at operation in 1930 indicated a transformation from cellular nevus to melanosarcoma.

Radium treatment postoperatively apparently arrested the conjunctival growth, but several months later the right preauricular lymph node became enlarged. Nine months after operation a fresh tumor developed in the tarsal conjunctiva of the right upper lid. This lesion was controlled by radium treatment given at Memorial Hospital. The enlarged lymph node removed at this institution was found to be melanoma. In March 1933 the right cervical and supraclavicular nodes became swollen. The patient's general health remained good until June, when pain developed in the left arm. Three weeks later he sustained a spontaneous fracture of the left clavicle, and death occurred from metastases to the brain in August of last year.

Dr. Smith stressed the importance of radical treatment of pigmented nevi as soon as they give definite evidence of growth. He stated that it was technically impossible to remove sufficient conjunctiva beyond the affected area, and thought that patients with this condition should be subjected to early enucleation of the eye or exenteration of the orbit, to be followed by application of radium to the orbit.

DISCUSSION

DR. W. GUERNSEY FREY JR.: On the two occasions when Dr. Smith's patient appeared before this group, I also presented a patient with a rather similar history, diagnosis and appearance, but there the parallelism ends, because my patient is still alive. I performed exenteration of the orbit in April 1933. The specimen revealed melanosarcoma of the spindle cell variety.

The usual destiny of such a patient is to go through life wearing a black patch over the deeply excavated orbit. To avoid this fate, this patient is wearing a lifelike prosthesis to cover the orbital aperture.

A CASE OF DOUBLE PAPILLITIS FOLLOWING MASTOID OPERATION. DR. ISAAC M. HELLER.

A girl of 12 developed diplopia two weeks after a mastoid operation on the left side in which the lateral sinus was opened and packed. There

were double abducens paresis and double choked disk, with a few minute retinal hemorrhages on the right. Strabismus became marked and papilledema increased to 3 diopters on the right and 2 diopters on the left. There were no other symptoms. A spinal tap revealed sterile spinal fluid under moderately increased pressure. Special taps have been repeated twice a week for four weeks; vision has remained 20/20— in each eye, and there have been no significant field changes. The diagnostic possibilities were discussed.

MENINGIOMAS OF THE SPHENOID RIDGE. DR. CHARLES A. ELSBERG.

This article will be published in full with the discussion in a later issue of the ARCHIVES.

Book Reviews

Seeing and Human Welfare. By Matthew Luckiesh, D.Sc., Director, Lighting Research Laboratory, General Electric Company. Price, $2.50. Pp. 193. Baltimore: Williams & Wilkins Company.

The author thinks that the present conditions of living, especially the housing conditions, have deprived modern man of much of the normal illumination to which his race was accustomed during its early development. To illustrate this fact, he states that at noon on a clear day, in direct sunlight, we are exposed to an illumination of about 10,000 foot candles, and in the shadow of a tree under the same conditions we have an illumination of about 1,000 foot candles, whereas indoors, by the aid of a 100 watt tungsten-filament lamp, at a distance of 3 feet, we have an illumination of only about 10 foot candles, and most persons submit to an illumination of even less intensity. Because of these conditions, we are living in a half-seeing world. In spite of the fact that our illumination is far subnormal and usually ill-directed and distributed, our eyes are called on to perform tasks far greater than ever before. This results in damage to the seeing organ, as in myopia, and in disturbances of the entire nervous mechanism of the body and great economic loss, because tasks depending on the act of seeing are done less perfectly and with greater nervous and muscular effort.

Classifying, correlating and bringing into use in the aid of the act of seeing all the functions and conditions having to do with this act, either directly or indirectly, he considers to be the science of seeing.

The book is not written in technical or scientific language and contains no new information, but does contain much useful information for the lay readers, especially those having charge of the lighting of schools, factories and department stores. The author describes what the requirements of the "seeing machine" are and instructs how best to meet these requirements.

There are a few minor inaccuracies in the book, one of which is the repeated assertion that a person becomes more far-sighted as he becomes presbyopic, the author evidently not realizing that in presbyopia there is simply loss of the focusing power, rendering near objects less easily seen, the punctum remotum remaining the same. A person with myopia of 1 diopter would require a plus reading glass after becoming presbyopic, but would not therefore be far-sighted. A. H. Thomasson.

Stereoskopische Bilder für schielende Kinder. By Prof. C. H. Sattler, Königsberg. Second edition, enlarged and revised. Price, 6.10 marks. Fifty-four double plates. Stuttgart: Ferdinand Enke, 1933.

In the new edition of Sattler's stereoscopic pictures for squinting children the pictures have been improved and increased in number. They have been selected to make them both interesting and suitable

for young children. The questions which are to be asked to get the child's attention will be found of great help to those to whom these exercises are entrusted.

ARNOLD KNAPP.

Bilder für stereoskopische Uebungen zum Gebrauch für Schielende. By Dr. C. Dahlfeld. In two parts. Thirteenth edition. Price, 5.85 marks each. Number of plates, 32 and 30. Stuttgart: Ferdinand Enke, 1933.

Dr. Dahlfeld's well known pictures for stereoscopic exercises have now appeared in a new edition, in two parts. The second part consists in reading charts and exercises to stimulate voluntary and binocular fusion and perception of depth. The subjects are well selected and are splendidly printed.

ARNOLD KNAPP.

Directory of Ophthalmologic Societies *

INTERNATIONAL

International Association for Prevention of Blindness

President: Prof. F. de Lapersonne, 217 Faubourg St. Honoré, Paris.
Secretary-General pro tem: Dr. A. Churchill, 66 Boulevard St. Michel, Paris.

International Ophthalmologic Congress

Secretary: Dr. Francisco Poyales, Olozaga 3, Madrid.

FOREIGN

British Medical Association, Section on Ophthalmology

President: Dr. Frank H. Crawley, 5 Fitzwilliam Pl., Dublin.

Ophthalmology Society of Bombay

President: Dr. D. D. Sathaye, 127 Girgaum Road, Bombay 4.
Secretary: Dr. H. D. Dastur, Dadar, Bombay 14.
Place: H. B. A. Free Ophthalmic Hospital, Parel, Bombay 12. Time: First Friday of every month.

Ophthalmological Society of the United Kingdom

President: Mr. A. H. H. Sinclair, 6 Charlotte Square, Edinburgh.
Secretary: Mr. Humphrey Neame, 56 Portland Place, London, W. I.

Oxford Ophthalmological Congress

Master: Dr. C. G. Russ Wood, Hill House, Abberbury Rd., Iffley, Oxford, England.
Hon. Secretary-Treasurer: Dr. F. A. Anderson, 12 St. John's Hill, Shrewsbury, England.
Place: Oxford. Time: July 4-6, 1935.

Royal Society of Medicine, Section of Ophthalmology

President: Dr. A. C. Hudson, 50, Queen Anne St., W. 1, London.
Secretary: Dr. J. D. Magor Carbell, 27, Weymouth St., W. 1, London.

Société Française d'Ophthalmologie

Secretary: Dr. René Onfray, 6 avenue de la Motte Picquet, Paris 7è.

Society of Swedish Ophthalmologists

President: Prof. F. Berg, Uppsala, Sweden.
Secretary: Dr. K. O. Granström, Södermalmstorg 4 III tr., Stockholm, Sö., Sweden.

German Ophthalmological Society

Secretary: Prof. A. Wagenmann, Heidelberg.

NATIONAL

American Medical Association, Scientific Assembly, Section on Ophthalmology

Chairman: Dr. Arthur J. Bedell, 344 State St., Albany, N. Y.
Secretary: Dr. Parker Heath, 1553 Woodward Ave., Detroit.
Place: Atlantic City, N. J. Time: June 10-14, 1935.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. J. M. Wheeler, 635 W. 165th St., New York.
President-Elect: Dr. Wells P. Eagleton, 15 Lombardy St., Newark, N. J.
Executive Secretary-Treasurer: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.

AMERICAN OPHTHALMOLOGICAL SOCIETY

President: Dr. W. G. M. Byers, 1458 Mountain St., Montreal.
Secretary-Treasurer: Dr. J. Milton Griscom, 2213 Walnut St., Philadelphia.

NATIONAL SOCIETY FOR THE PREVENTION OF BLINDNESS

President: Mr. William Fellows Morgan.
Managing Director: Mr. Lewis H. Carris, 50 W. 50th St., New York.
Place: New York. Time: November, 1934.

SECTIONAL

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

President: Dr. Hugo B. C. Riemer, 128 Newbury St., Boston.
Secretary-Treasurer: Dr. Benjamin Sachs, 483 Beacon St., Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

PACIFIC COAST OTO-OPHTHALMOLOGICAL SOCIETY

President: Dr. Frank B. Kistner, Mayer Bldg., Portland, Ore.
Secretary-Treasurer: Dr. Frederick C. Cordes, 384 Post St., San Francisco.
Place: Portland, Ore. Time: Spring, 1935.

PUGET SOUND ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Francis A. Brugman, 509 Olive St., Seattle.
Secretary-Treasurer: Dr. Noble Dick, 1115 Terry Ave., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

ROCK RIVER VALLEY EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Harry Shearer, 405 E. Grand Ave., Beloit, Wis.
Secretary-Treasurer: Dr. W. S. Beyer, 1101 Talcott Bldg., Rockford, Ill.
Place: Rockford, Ill., Janesville or Beloit, Wis. Time: Third Tuesday of each month.

SAGINAW VALLEY ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. A. R. McKinney, 703 Second National Bank Bldg., Saginaw, Mich.
Secretary-Treasurer: Dr. W. K. Slack, 308 Eddy Bldg., Saginaw, Mich.
Place: Saginaw, Mich., or Bay City, Mich. Time: First Friday of each month, except July and August.

SIOUX VALLEY EYE AND EAR ACADEMY

President: Dr. John B. Gregg, 101 S. Main St., Sioux Falls, S. D.
Secretary-Treasurer: Dr. F. H. Roost, 420 Trimble Bldg., Sioux City, Iowa.

SOUTHERN MEDICAL ASSOCIATION, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. Dunbar Roy, 113 N. Pryor St., Atlanta, Ga.
Secretary: Dr. William A. Wagner, 914 American Bank Bldg., New Orleans.
Place: New Orleans. Time: 1934.

SOUTHWESTERN MICHIGAN TRIOLOGICAL SOCIETY

President: Dr. Carl Snapp, 604 Medical Arts Bldg., Grand Rapids.
Secretary-Treasurer: Dr. Lee O. Grant, 420 Medical Arts Bldg., Grand Rapids.
Time: Third Thursday of alternate months.

WESTERN PENNSYLVANIA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. O. G. A. Barker, 532 Main St., Johnstown.
Secretary-Treasurer: Dr. C. W. Beals, Weber Bldg., DuBois.
Time: Third Thursday of October and May.

STATE

COLORADO OPHTHALMOLOGICAL SOCIETY

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. Edna M. Reynolds, 920 Republic Bldg., Denver.
Place: Capitol Life Building, Denver. Time: 7:30 p. m., third Saturday of the month, October to April, inclusive.

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON EYE, EAR, NOSE AND THROAT

President: Dr. Edward J. Whalen, 750 Main St., Hartford.
Secretary-Treasurer: Dr. Walter L. Hogan, 750 Main St., Hartford.
Time: May, November.

EYE, EAR, NOSE AND THROAT CLUB OF GEORGIA

President: Dr. W. R. Bedingfield, 753 Broad St., Augusta.
Secretary-Treasurer: Dr. J. A. Smith, 700 Spring St., Macon.

INDIANA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. J. Kent Leasure, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Fred Overman, 611 Hume-Mansure Bldg., Indianapolis.
Place: Richmond. Time: Dec. 12, 1934.

IOWA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. W. F. Boiler, 105 E. Iowa Ave., Iowa City.
Secretary-Treasurer: Dr. Lawrence A. Taylor, 118 E. Second St., Ottumwa.

MICHIGAN STATE MEDICAL SOCIETY, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. Peter T. Grant, 148 Monroe Ave., Grand Rapids.
Secretary: Dr. Ralph B. Fast, 1410 Bank of Kalamazoo Bldg., Kalamazoo.
Place: Battle Creek. Time: 1934.

MINNESOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Gordon B. New, Mayo Clinic, Rochester.
Secretary-Treasurer: Dr. Walter E. Camp, Medical Arts Bldg., Minneapolis.
Time: Second Friday of each month from October to May.

MONTANA ACADEMY OF OTO-OPHTHALMOLOGY

President: Dr. Lawrence G. Dunlap, 101 Main St., Anaconda.
Secretary: Dr. A. W. Morse, Phoenix Bldg., Butte.

NEW JERSEY STATE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY, OTOLOGY AND RHINOLARYNGOLOGY

Chairman: Dr. S. T. Hubbard, 294 State St., Hackensack.
Secretary: Dr. G. S. Laird, 125 Central Ave., Westfield.

NEW YORK STATE MEDICAL SOCIETY, EYE, EAR, NOSE AND THROAT SECTION

Chairman: Dr. Frank M. Sulzman, 1831 Fifth Ave., Troy.
Secretary: Dr. Webb W. Weeks, 20 E. 53rd St., New York.

NORTH DAKOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY
President: Dr. H. O. Ruud, 318 De Mers Ave., Grand Forks.
Secretary-Treasurer: Dr. F. L. Wicks, 516 Fourth St., Valley City.
Place: Valley City. Time: 1934.

OREGON ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY
President: Dr. A. B. Dykman, Medical Dental Bldg., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

RHODE ISLAND OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY
President: Dr. Robert C. O'Neil, 105 Waterman St., Providence.
Secretary and Treasurer: Dr. Gordon J. McCurdy, 122 Waterman St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY
President: Dr. Walter Bristow, Medical Bldg., Columbia.
Secretary: Dr. J. W. Jervey, Jr., 101 Church St., Greenville.

TENNESSEE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY
President: Dr. C. D. Blassingame, 899 Madison Ave., Memphis.
Secretary-Treasurer: Dr. Ralph O. Rychener, 130 Madison Ave., Memphis.

TEXAS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY
President: Dr. C. C. Cody, 1304 Walker Ave., Houston.
Secretary: Dr. O. M. Marchman, 1719 Pacific Ave., Dallas.

UTAH OPHTHALMOLOGICAL SOCIETY
President: Dr. F. R. Slopanskey, 9 Exchange Pl., Salt Lake City.
Secretary-Treasurer: Dr. T. F. Welsh, 920 Boston Bldg., Salt Lake City.
Time: Third Monday of each month.

VIRGINIA SOCIETY OF OTO-LARYNGOLOGY AND OPHTHALMOLOGY
President: Dr. Beverley R. Kennon, 142 W. York St., Norfolk.
Secretary-Treasurer: Dr. George G. Hankins, Medical Arts Bldg., Newport News.

WEST VIRGINIA STATE MEDICAL ASSOCIATION, EYE, EAR, NOSE AND THROAT SECTION
President: Dr. Harry V. Thomas, 95 Fairmont Ave., Fairmont.
Secretary: Dr. W. F. Beckner, 1050 Fifth Ave., Huntington.

LOCAL

ACADEMY OF MEDICINE OF NORTHERN NEW JERSEY, SECTION ON EYE, EAR, NOSE AND THROAT
Chairman: Dr. Browne Morgan, 260 Liberty St., Bloomfield.
Secretary: Dr. A. Russell Sherman, 671 Broad St., Newark.
Place: 91 Lincoln Park South, Newark. Time: 8:45 p. m., second Monday of each month.

ACADEMY OF MEDICINE OF TORONTO, SECTION OF OPHTHALMOLOGY
Chairman: Dr. Colin Campbell, 170 St. George St., Toronto.
Secretary: Dr. H. M. Macrae, 170 St. George St., Toronto.
Time: First Monday of winter months.

ATLANTA EYE, EAR, NOSE AND THROAT SOCIETY
President: Dr. W. L. McDougall, 50 Whitehall St., Atlanta, Ga.
Secretary: Dr. William O. Martin, Jr., 384 Peachtree St., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St., N. E. Time: 8 p. m., last Thursday of each month.

Baltimore Medical Society, Section on Ophthalmology

Chairman: Dr. Lloyd B. Whitham, Mt. Vernon Pl. and Charles St., Baltimore.
Secretary: Dr. Mary L. Small, 18 W. Read St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

Brooklyn Ophthalmological Society

President: Dr. John H. Bailey, 855 St. Marks Ave., Brooklyn.
Secretary-Treasurer: Dr. George Freiman, 703 Grand St., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday in February, April, May, October and December.

Buffalo Ophthalmologic Club

President: Dr. H. H. Glosser, 448 Franklin St., Buffalo.
Secretary-Treasurer: Dr. I. J. Koenig, 40 North St., Buffalo.

Chicago Ophthalmological Society

President: Dr. E. V. L. Brown, 122 S. Michigan Ave., Chicago.
Secretary-Treasurer: Dr. Thomas D. Allen, 122 S. Michigan Ave., Chicago.
Place: Medinah Michigan Avenue Club, 505 N. Michigan Ave. Time: Third Monday of each month from October to May.

Cleveland Academy of Medicine, Section of Ophthalmology and Otolaryngology

Chairman: Dr. A. L. Stotter, 1148 Euclid Ave., Cleveland.
Secretary: Dr. James T. Collins, 1105 Medical Arts Bldg., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

Cleveland Ophthalmological Club

Chairman: Dr. W. P. Chamberlain, 7405 Detroit Ave., Cleveland.
Secretary: Dr. A. D. Ruedemann, Cleveland Clinic, Cleveland.

College of Physicians, Philadelphia, Section on Ophthalmology

Chairman: Dr. John Milton Griscom, 2213 Walnut St., Philadelphia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

Columbus Ophthalmological and Oto-Laryngological Society

Chairman: Dr. Albert D. Frost, 681 E. Broad St., Columbus, Ohio.
Secretary-Treasurer: Dr. M. Goldberg, 328 E. State St., Columbus, Ohio.
Time: First Monday of each month.

Dallas Academy of Ophthalmology and Oto-Laryngology

President: Dr. T. S. Love, 1719 Pacific Ave., Dallas, Texas.
Secretary: Dr. Daniel Brannin, 1719 Pacific Ave., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Des Moines Academy of Ophthalmology and Otolaryngology

President: Dr. C. C. Walker, 410 6th Ave., Des Moines, Iowa.
Secretary-Treasurer: Dr. Grace Doane, 614 Bankers Trust Bldg., Des Moines, Iowa.
Time: 7:45 p. m., third Monday of every month, September to May.

Detroit Ophthalmological Club

Chairman: Members rotate alphabetically.
Secretary: Dr. Raymond S. Goux, David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. Edward B. O'Keefe, 901 State St., Schenectady.
Secretary-Treasurer: Dr. W. C. Mott, 118 Washington Ave., Albany.
Time: Third Wednesday in October, November, March, April, May and June.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. E. L. Howard, 600 W. 10th St., Fort Worth, Texas.
Secretary-Treasurer: Dr. Van D. Rathgeber, 1012 Medical Arts Bldg., Fort Worth.
Place: Medical Hall, Medical Arts Bldg. Time: 7:30 p. m., first Friday of each month except July and August.

Grand Rapids Eye, Ear, Nose and Throat Society

President: Dr. Carl F. Snapp, 26 Sheldon Ave., Grand Rapids, Mich.
Secretary-Treasurer: Dr. Walter W. Oliver, 320 Medical Arts Bldg., Grand Rapids, Mich.
Place: Various local hospitals. Time: Third Thursday of alternating months, September to May.

Houston Academy of Medicine, Eye, Ear, Nose and Throat Section

President: Dr. E. L. Goar, 1304 Walker Ave., Houston, Texas.
Secretary: Dr. J. C. Dickson, 622 Medical Arts Bldg., Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., second Thursday of each month from September to June.

Indianapolis Ophthalmological and Otolaryngological Society

President: Dr. D. A. Bartley, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, 23 E. Ohio St., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

Kansas City Society of Ophthalmology and Oto-Laryngology

President: Dr. M. B. Simpson, 1103 Grand Ave., Kansas City, Mo.
Secretary: Dr. Harold B. Hedrick, 618 Professional Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

Long Beach Eye, Ear, Nose and Throat Society

Chairman: Dr. Russell T. Uhls, 110 Pine Ave., Long Beach, Calif.
Secretary-Treasurer: Dr. Kenneth C. Brandenburg, 707 Security Bldg., Long Beach, Calif.
Place: Professional Bldg. Time: Last Wednesday of each month from October to May.

Los Angeles Society of Ophthalmology and Oto-Laryngology

President: Dr. F. H. Brandt, 1136 W. Sixth St., Los Angeles.
Secretary-Treasurer: Dr. Pierre Viole, 1930 Wilshire Blvd., Los Angeles.
Place: Los Angeles County Medical Association Bldg., 1925 Wilshire Blvd. Time: 6:30 p. m., fourth Monday of each month from September to May, inclusive.

Louisville Eye, Ear, Nose and Throat Society

President: Dr. Charles Dwight Townes, 332 W. Broadway, Louisville, Ky.
Secretary-Treasurer: Dr. J. S. Bumgardner, 1103 Heyburn Bldg., Louisville, Ky.
Place: French Village. Time: 6:30 p. m., second Thursday of each month from September to May, inclusive.

Medical Society of the District of Columbia, Section of Ophthalmology and Oto-Laryngology

Chairman: Dr. George B. Trible, 1801 I St., Washington.
Secretary: Dr. Harry F. Davies, 1835 I St., Washington.
Place: 1718 M St., N. W. Time: 8 p. m., third Friday of each month from October to April, inclusive.

Memphis Society of Ophthalmology and Otolaryngology

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, Exchange Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

Milwaukee Oto-Ophthalmic Society

Secretary-Treasurer: Dr. Herbert G. Schmidt, 238 W. Wisconsin Ave., Milwaukee.
President: Dr. O. P. Schoofs, 324 E. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., fourth Tuesday of each month.

Montreal Ophthalmological Society

President: Dr. J. A. MacMillan, 1410 Stanley St., Montreal, Canada.
Secretary: Dr. A. L. Guertin, 410 Sherbrooke St., West, Montreal, Canada.
Time: Second Thursday of October, December, February and April.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. Frederick E. Hasty, 119 Seventh Ave. N., Nashville, Tenn.
Secretary-Treasurer: Dr. Kate Savage Zerfoss, 803 Medical Arts Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month from October to June.

New Orleans Ophthalmological and Otolaryngological Society

President: Dr. M. F. Meyer, Canal Bank Bldg., New Orleans.
Secretary-Treasurer: Dr. R. H. Fisher, Chess and Checker Club, New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: Third Thursday of each month from October to June.

New York Academy of Medicine, Section of Ophthalmology

Chairman: Dr. Webb William Weeks, 20 E. 53d St., New York.
Secretary: Dr. Guernsey Frey, 121 E. 60th St., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

Omaha and Council Bluffs Ophthalmological and Oto-Laryngological Society

President: Dr. Abbott M. Dean, 532 First Ave., Council Bluffs, Iowa.
Secretary-Treasurer: Dr. Robert H. Rasgorshek, 425 Aquila Court, Omaha.
Place: Omaha Club, 20th and Douglas Sts., Omaha. Time: 6 p. m., dinner; 7 p. m., program; third Wednesday of each month from October to May.

Philadelphia County Medical Society, Eye Section

Chairman: Dr. Charles R. Heed, 1205 Spruce St., Philadelphia.
Secretary: Dr. Sidney L. Olsho, 235 S. 15th St., Philadelphia.
Time: First Thursday of each month from October to May.

Pittsburgh Ophthalmological Society

President: Dr. Edward B. Heckel, Jenkins Arcade Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

Pittsburgh Slit-Lamp Society

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: 121 University Pl. Time: Second Monday evening of every month, except June, July, August and September.

Richmond Ophthalmological and Oto-Laryngological Society

President: Dr. F. H. Lee, 501 E. Franklin St., Richmond, Va.
Secretary: Dr. William R. Weisiger, Medical Arts Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

Rochester Eye, Ear, Nose and Throat Society

President: Dr. E. W. O'Brien, 5 N. Goodman St., Rochester, N. Y.
Secretary-Treasurer: Dr. W. D. Edwards, 389 Monroe Ave., Rochester, N. Y.
Place: Rochester Medical Association, 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

St. Louis Ophthalmic Society

President: Dr. E. C. Spitze, 234 Collinsville Ave., East St. Louis, Ill.
Secretary: Dr. Carl T. Eber, 1006 Carleton Bldg., St. Louis.
Place: Oscar Johnson Institute. Time: Clinical meeting 5:30 p. m., dinner and scientific meeting 6:30 p. m., fourth Friday of each month from October to April, inclusive, except December.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. Robert E. Parrish, 712 Medical Arts Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. Frank Steed, Nix Professional Bldg., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

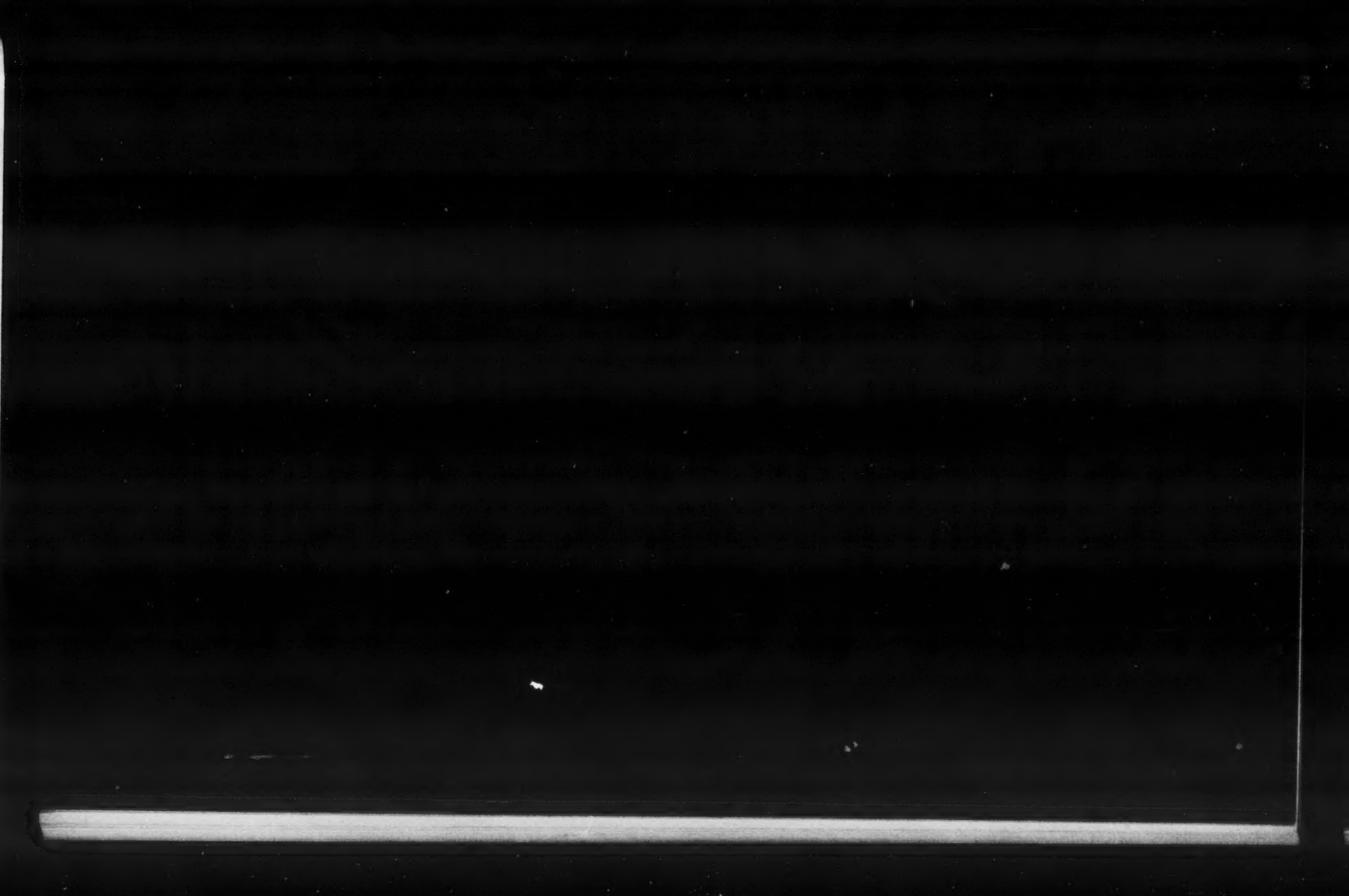
Chairman: Dr. Robert S. Irvine, 490 Post St., San Francisco.
Secretary: Dr. Frank H. Rodin, 490 Post St., San Francisco.
Place: Society's Building, 2180 Washington St., San Francisco.
Time: Fourth Tuesday of every month except May, June, July and December.

Shreveport Eye, Ear, Nose and Throat Society

President: Dr. W. L. Atkins, 940 Margaret Pl., Shreveport, La.
Secretary-Treasurer: Dr. Leon F. Gray, 1214 Slattery Bldg., Shreveport, La.
Place: 1240 Texas Ave. Time: 8:15 p. m., fourth Tuesday of every month except June, July and December.

Spokane Academy of Ophthalmology and Oto-Laryngology

President: Dr. Marc Anthony, 422 Riverside Ave., Spokane, Wash.
Secretary: Dr. Raymond A. Lower, 1455 Paulsen Medical and Dental Bldg., Spokane, Wash.
Place: Paulsen Medical and Dental Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. H. O. Brust, 820 S. Crouse Ave., Syracuse, N. Y.
Secretary-Treasurer: Dr. W. J. Werfelmann, 109 S. Warren St., Syracuse, N. Y.
Place: University Club. Time: Second Friday of each month except June, July and August.